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Director

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Hydraulic Laboratory Bulletin
Series A

CURRENT HYDRAULIC LABORATORY RESEARCH IN THE UNITED STATES.

Bulletin IV-1
January 1, 1936

WASHINGTON

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CURRENT HYDRAULIC LABORATORY RESEARCH
IN THE UNITED STATES.

Compiled by the National Bureau of Standards,
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Washington, D. C.

Hydraulic Laboratory Bulletin Series A

Volume IV, Number 1. January 1, 1936.

INTRODUCTION.

An unexpected increase in the demand for these bulletins, both current and back numbers, has exhausted our supply of nearly all of the issues that have appeared. The number of copies in future issues will be increased in an attempt to avoid this in the future. The following list shows the status of all issues of this bulletin and of the bulletins describing the hydraulic laboratories in the United States. In the future these bulletins will be designated as National Bureau of Standards Hydraulic Laboratory Bulletins, Series A (current hydraulic laboratory research) and Series B (description of hydraulic laboratories), respectively

Series A.

Bulletin I-1, April 1, 1933.
" I-2, July 1, 1933. Out of print.
" I-3, October 1, 1933.
" II-1, January 1, 1934. Out of print.
" II-2, July 1, 1934. Out of print.
" III-1, January 1, 1935. Out of print.
" III-2, July 1, 1935. Out of print.

Series B.

Hydraulic Laboratories in the United States (1933).
Hydraulic Laboratories in the United States, 1st revision, 1935.

Since some of the laboratories reporting projects for inclusion in a given bulletin fail to respond to the notice sent out before the next bulletin is issued, it is necessary for us to decide in such cases whether projects reported by these laboratories shall be repeated in subsequent issues. It seems to be impossible to make any general rules for deciding such cases, so each case will be decided on its own merits. However, if a laboratory fails to respond to the notices for two consecutive issues of the bulletin, the projects which it had reported previously will be omitted thereafter.

Attention is called particularly to the notice in this bulletin concerning the founding in September, 1935, of an International Association for Research on Hydraulic Structures. The founding of this Association constitutes the most important step that has been taken in the direction of promoting international cooperation in hydraulic research, particularly with regard to model tests and their verification in nature, and of interchanging

and publishing the results of such research. It is to be hoped that there will be a prompt response in the United States to the call for members, since the scope of the Association's activities will depend, at least at first, entirely upon its income from dues.

Your attention is called to the fact that as a rule the Hydraulic Laboratory Section of the National Bureau of Standards does not have detailed information or copies of publications relating to the projects listed in these bulletins. For information always apply to the "Correspondent" whose na[me] is listed under paragraph (e) for each project.

CURRENT PROJECTS IN HYDRAULIC LABORATORIES.

(Key)

(a) Title of project:
(b) Project conducted for:
(c) Conducted as:
(d) Investigators:
(e) Correspondent:
(f) Purpose:
(g) Method and Scope:
(h) Progress:
(i) Remarks:

BALDWIN-SOUTHWARK CORPORATION.

(352)(a) EFFICIENCY AND HORSEPOWER TESTS - BEAUHARNOIS MODEL TURBINE.
(b) Dominion Engineering Works, Ltd., Montreal.
(c) Commercial research.
(d) S. Logan Kerr, Research Engineer.
(e) S. Logan Kerr, Research Engineer.
(f) To investigate the effect of variation in runner and guide vane design in the 53,000 hp units for the Beauharnois Development.
(g) An exact scale model of the intake, casing, turbine and draft tube was made and various types of guide vanes, runners and other parts tested. The original series of tests were made in the flume of the Holyoke Water Power Co., Holyoke, Mass., and check tests were made in the same equipment in the Alden Hydraulic Laboratory, Worcester Polytechnic Institute. The second series of tests was made in the I. P. Morris laboratory at Eddystone, Pa. The second series comprised 40 or 50 complete tests with alterations made to runners and guide vanes to study the effect of these changes. Special paint tests were developed to show the flow characteristics of the turbine runner to obtain visual records of the effect of runner alterations.
(h) Final group of tests now in progress.
(i) Data secured on this investigation being used for the improved performance of the additional units to be installed in Beauharnois Development.

....

(354)(a) EFFICIENCY AND HORSEPOWER TESTS - WHEELER DAM UNIT.
(b) Tennessee Valley Authority.
(c) Research preparatory to final design and manufacture and guarantee tests.
(d) S. Logan Kerr, Research Engineer.
(e) S. Logan Kerr, Research Engineer.
(f) Investigations to establish the design of the final propeller type unit to be installed at Wheeler Dam rated at 45,000 hp under 48 ft head at 85.6 rpm. The nature of this project requires that the highest efficiency be obtained and that the point of best efficiency occur at the correct discharge. The arrangement of the installation at Wheeler Dam makes it extremely difficult to conduct accurate performance tests in the field. The guarantee tests are, therefore, being conducted in the experimental laboratory to establish the performance of the main unit in the field.
(g) An exact model has been made of the complete hydraulic installation including intake, racks, piers, casing, turbine and draft tube. Complete characteristic curves for full range of gate openings, speed and head conditions were made on each model runner tested, blade setting of model runner adjusted to give correct characteristics.
(h) Tests are in progress.

....

(355)(a) EFFICIENCY AND HORSEPOWER TESTS - FRANCIS TURBINE.
(b) Loup River Public Power District, Columbus Development.
(c) Research preparatory to final design and manufacture.
(d) S. Logan Kerr, Research Engineer.
(e) S. Logan Kerr, Research Engineer.
(f) Determination of correct design of complete turbine, draft tube to secure the best performance including the design and position of the baffle in the turbine draft tube.
(g) Exact model was made of the turbine and draft tube and tested as an open flume unit with various Francis Runner designs, and with different positions of the draft tube baffle.
(h) Tests in progress.

....

UNIVERSITY OF CALIFORNIA.

(16) (a) EVAPORATION BY FREE CONVECTION.
(c) Laboratory project.
(d) B. F. Sharpley and C. W. Quentel.
(e) Professor M. P. O'Brien.
(h) Experiments in progress.

....

(17) (a) TRANSPORTATION OF BED LOAD BY STREAMS.
(b) Corps of Engineers, U.S.A.
(d) Professor M. P. O'Brien.
(e) Professor M. P. O'Brien.
(g) Studies in tilting flume 3 feet wide and 18 inches deep.
(h) Experiments in progress.

....

(269)(a) PROPELLER PUMPS.
(c) Laboratory project.
(d) Folsom.
(e) Professor M. P. O'Brien.
(E) Theory developed by O'Brien and Folsom is being extended to computation of characteristics of propeller fans.

....

(273)(a) EFFECT OF VISCOSITY ON WEIR DISCHARGE.
(c) Laboratory project.
(d) Carson.
(e) Professor M. P. O'Brien.
(g) Tests will be made on triangular weirs using oils of different viscosities.
(h) Experimental work in progress.

....

(276)(a) DISCHARGE COEFFICIENTS OF SHARP-CRESTED WEIRS, IRREGULAR IN PLAN.
(c) Undergraduate thesis.
(d) Gray.
(e) Professor M. P. O'Brien.
(g) Continuation of laboratory tests.
(h) Experiments in progress.

....

(278)(a) CHARACTERISTICS OF DISC-FRICTION PUMPS.
(c) Laboratory project.
(d) R. G. Folsom and A. W. Everett.
(e) Professor M. P. O'Brien.
(f) To develop a theory of the performance of the turbulence type of pump.
(g) Tests of Westeo and Burke type of pumps.
(h) Experimental work in progress and partial report prepared.

....

(279)(a) SCOUR BELOW DAMS.
(c) Undergraduate thesis.
(d) Haavik and Hoffman.
(e) Professor M. P. O'Brien.
(g) Study of scour below scale models.
(h) Experiments in progress.

....

(280)(a) ORIFICES FOR MEASURING DISCHARGE AT END OF PIPE LINE.
(c) Laboratory project.
(d) O'Brien and Folsom.
(e) Professor M. P. O'Brien.
(f) To standardize a set of orifice plates for field measurement of pump discharge. Design is a modification of the International Standard Orifice.
(h) Tests completed and partial report prepared.

....

(281)(a) MODEL OF ESTUARY OF COLUMBIA RIVER.
(b) Corps of Engineers, U.S.A.
(d) M.P.O'Brien.
(e) M. P. O'Brien.
(f) To investigate channel regulation in the Columbia River estuary.
(g) Investigations are being undertaken on movable and fixed bed models with horizontal scale of 1:3600 and vertical scales of 1:64 and 1:128. Tides and waves are being reproduced.
(h) Experimental work in progress.

. . . .

(419)(a) DETERMINATION AND CORRELATION OF VIRTUAL MASS OF SHIP MODELS.
(c) Graduate Thesis.
(d) J. P. Murphy.
(e) Professor M. P. O'Brien.
(g) Experiments with ship model towing equipment.
(h) Experimental work in progress.

. . . .

(420)(a) BROAD CRESTED WEIRS.
(c) Undergraduate thesis.
(d) Davis and Sullivan.
(e) Professor M.P.O'Brien.
(f) Test of model laws.

. . . .

(421)(a) SIMILARITY OF MODELS.
(c) Graduate thesis.
(d) Taylor.
(e) Professor M.P.O'Brien.
(h) Experiments in progress.

. . . .

(422)(a) STANDARD JUMP-DROP FOR IRRIGATION CANALS.
(c) Laboratory project.
(d) Stoker.
(e) Professor M.P.O'Brien.
(f) Determination of necessary length of depressed section.

. . . .

(423)(a) FLOOD WAVES.
(c) Graduate thesis.
(d) Matheson.
(e) Professor M.P.O'Brien.
(g) Investigation of waves in power canals by means of model channel.

. . . .

(424)(a) IMPACT LOSS AT CONVERGENCE OF STREAMS.
(c) Laboratory project.
(e) Professor M.P.O'Brien.
(g) Experimental investigation with channels of 4-inch widths, meeting at various angles.
(h) Equipment being constructed.

. . . .

(425)(a) SAND MOVEMENT AND BEACH EROSION.
(c) Graduate thesis.
(d) Meyers.
(e) Professor M.P.O'Brien.
(f) Investigation of the equilibrium profile of a beach as a function of the size of material, wave height and period, and range of tide.
(h) Wave tank and machine constructed and experiments in progress.

....

(426)(a) HYDRAULIC ROUGHNESS.
(c) Laboratory project.
(d) Folsom, Pendergast, Tripp.
(e) Professor M.P.O'Brien.
(f) Investigation of methods to measure roughness.
(g) Experimental investigations in water channel with brass walls containing roughness and in air channel with wooden walls.
(h) Water channel built and experiments in progress.

....

(427)(a) FRICTION LOSSES IN ESTUARIES.
(c) Laboratory project.
(d) Arnold.
(e) Professor M.P.O'Brien.
(g) Application of theory of E.I.Brown to field and laboratory measurements of estuary of Columbia River.
(h) Work in progress.

....

CASE SCHOOL OF APPLIED SCIENCE.

(428)(a) WILLS CREEK DAM NEAR CONESVILLE, OHIO, MUSKINGUM WATERSHED PROJECT.
(b) U. S. Engineer Department, Zanesville District.
(c) Laboratory investigation on a model dam.
(d) Professor George E. Barnes, J. G. Jobes, Associate Engineer, G. Brooks Earnest, W. A. Snyder, W. J. Hotkie and staff.
(e) The District Engineer, U. S. Engineer Office, Zanesville, Ohio.
(f) To determine performance of proposed design, and to obtain supporting data for improvements and operation.
(g) 1:40 and 1:25 scale model tests on multiple gate structure, twin tunnels, and stilling basin.
(h) Completed: data submitted in report to Major J. D. Arthur, Jr., District Engineer, under date of December 20, 1934.
(i) Information concerning tests on this project may be had through the District Engineer, U. S. Engineer Office, Zanesville, Ohio. Abstract in this bulletin.

....

(429)(a) CHARLES MILL DAM NEAR MANSFIELD, OHIO, MUSKINGUM WATERSHED PROJECT.
(b) U. S. Engineer Department, Zanesville District.
(c) Laboratory investigation on a model dam.
(d) Professor George E. Barnes, J. G. Jobes, Associate Engineer, G. Brooks Earnest, W. A. Snyder, W. J. Hotkie and staff.
(e) The District Engineer, U. S. Engineer Office, Zanesville, Ohio.
(f) To determine performance of proposed design, and to obtain supporting data for improvements and operation.
(g) 1:30 and 1:20 scale model tests on outlet conduits through masonry overflow section, stilling basin, and spillway.
(h) Completed: data submitted in report to Major J. D. Arthur, Jr., District Engineer, under data of March 1, 1934.
(i) Information concerning tests on this project may be had through the District Engineer, U.S.Engineer Office, Zanesville, Ohio. Abstract in this bulletin.

....

(430)(a) TAPPAN DAM, LITTLE STILLWATER CREEK, OHIO, MUSKINGUM WATERSHED PROJECT.
(b) U. S. Engineer Department, Zanesville District.
(c) Laboratory investigation on a model dam.
(d) Professor George E. Barnes, J. G. Jobes, Associate Engineer, G. Brooks Earnest, W. A. Snyder, W. J. Hotkie and staff.
(e) The District Engineer, U. S. Engineer Office, Zanesville, Ohio.
(f) To determine performance of proposed design, and to obtain supporting data for improvements and operation.
(g) Constructed 1:20 scale model of the tunnel, outlet portal, stilling basin, and outlet channel.
(h) Completed: data submitted in report to Major J. D. Arthur, Jr., District Engineer, under date of March 20, 1935.
(i) Same as (i) above.

....

(431)(a) CLENDENING DAM, BRUSHY FORK, LITTLE STILLWATER CREEK, OHIO, MUSKINGUM WATERSHED PROJECT.
(b) U. S. Engineer Department, Zanesville District.
(c) Laboratory investigation on a model dam.
(d) Professor George E. Barnes, J. G. Jobes, Associate Engineer, G. Brooks Earnest, W. A. Snyder, W. J. Hotkie and staff.
(e) The District Engineer, U. S. Engineer Office, Zanesville, Ohio.
(f) To determine performance of proposed design, and to obtain supporting data for improvements and operation.
(g) Constructed 1:20 scale model of tunnel, outlet portal, stilling basin, and outlet channel.
(h) Completed: data submitted in report to Major J. D. Arthur, Jr., District Engineer, under date of March 30, 1935.
(i) Information concerning tests on this project may be had through the District Engineer, U. S. Engineer Office, Zanesville, Ohio. Abstract in this bulletin.

....

(432)(a) PIEDMONT DAM NEAR PIEDMONT, OHIO, MUSKINGUM WATERSHED PROJECT.
(b) U.S.Engineer Department, Zanesville District.
(c) Laboratory investigation on a model dam.
(d) Professor George E. Barnes, J. G. Jobes, Associate Engineer, G. Brooks Earnest, W. A. Snyder, W. J. Hotkie and staff.
(e) The District Engineer, U. S. Engineer Office, Zanesville, Ohio.
(f) To determine performance of proposed design, and to obtain supporting data for improvements and operation.
(g) Constructed 1:20 scale model of tunnel, outlet portal, stilling basin, and outlet channel.
(h) Completed: data submitted in report to Major J. D. Arthur, Jr., District Engineer, under date of April 5, 1935.
(i) Information concerning tests on this project may be had through the District Engineer, U. S. Engineer Office, Zanesville, Ohio. Abstract in this bulletin.

....

(433)(a) DOVER DAM, TUSCARAWAS RIVER NEAR DOVER, OHIO, MUSKINGUM WATERSHED PROJECT.
(b) U. S. Engineer Department, Zanesville District.
(c) Laboratory investigation on a model dam.
(d) Professor George E. Barnes, J. G. Jobes, Associate Engineer, G. Brooks Earnest, W. A. Snyder, W. J. Hotkie and staff.
(e) The District Engineer, U.S.Engineer Office, Zanesville, Ohio.
(f) To determine performance of proposed design, and to obtain supporting data for improvements and operation.
(g) 1:35 scale model of solid masonry overflow section with 18 outlet conduits and stilling pool.
(h) Completed: data submitted in report to Major J. D. Arthur, Jr., District Engineer, under date of April 30, 1935.
(i) Information concerning tests on this project may be had through the District Engineer, U. S. Engineer Office, Zanesville, Ohio. Abstract in this bulletin.

....

(434)(a) MOHAWK DAM ON WALHONDING RIVER NEAR WARSAW, OHIO, MUSKINGUM WATERSHED PROJECT.
(b) U. S. Engineer Department, Zanesville District.
(c) Laboratory investigation on a model dam.
(d) Professor George E. Barnes, J. G. Jobes, Associate Engineer, G. Brooks Earnest, W. A. Snyder, W. J. Hotkie andstaff.
(e) The District Engineer, U. S. Engineer Office, Zanesville, Ohio.
(f) To determine performance of proposed design, and to obtain supporting data for improvements and operation.
(g) 1:40 scale model of multiple gate intake structure, twin tunnels and stilling basin.
(h) Completed: data submitted in report to Major J.D.Arthur, Jr., District Engineer, under date of April 22, 1935.
(i) Information concerning tests on this project may be had through the District Engineer, U.S.Engineer Office, Zanesville, Ohio. Abstract in this bulletin.

....

(435)(a) BOLIVAR DAM ON SANDY CREEK NEAR BOLIVAR, OHIO, MUSKINGUM WATERSHED PROJECT.
(b) U. S. Engineer Department, Zanesville District.
(c) Laboratory investigation on a model dam.
(d) Professor George E. Barnes; J. G. Jobes, Associate Engineer, G. Brooks Earnest, W. A. Snyder, W. J. Hotkie and Staff.
(e) The District Engineer, U. S. Engineer Office, Zanesville, Ohio.
(f) To determine performance of proposed design, and to obtain supporting data for improvements and operation.
(g) 1:40 scale model twin multiple gate intake, twin tunnels, and stilling basin.
(h) Completed: data submitted in report to Major J. D. Arthur, Jr., District Engineer, under date of April 13, 1935.
(i) Information concerning tests on this project may be had through the District Engineer, U. S. Engineer Office, Zanesville, Ohio. Abstract in this bulletin.

....

(436)(a) SENECAVILLE DAM ON SENECA FORK, WILLS CREEK NEAR SENECAVILLE, OHIO, MUSKINGUM WATERSHED PROJECT.
(b) U. S. Engineer Department, Zanesville District.
(c) Laboratory investigation on a model dam.
(d) Professor George E. Barnes, J. G. Jobes, Associate Engineer, G. Brooks Earnest, W. A. Snyder, W. J. Hotkie and staff.
(e) The District Engineer, U. S. Engineer Office, Zanesville, Ohio.
(f) To determine performance of proposed design, and to obtain supporting data for improvements and operation.
(g) 1:20 scale model of twin outlet conduits through masonry section, twin overflow sections with Taintor control gates, outlet channel through rock cut, and stilling basin.
(h) Completed: data submitted in report to Major J. D. Arthur, Jr., District Engineer, under date of May 8, 1935.
(i) Information concerning tests on this project may be had through the office of the District Engineer, U.S.Engineer Office, Zanesville, Ohio. Abstract in this bulletin.

....

(437)(a) MOHICANVILLE DAM ON LAKE FORK, MOHICAN RIVER, OHIO, MUSKINGUM WATERSHED PROJECT.
(b) U. S. Engineer Department, Zanesville District.
(c) Laboratory investigation on a model dam.
(d) Professor George E. Barnes, J. G. Jobes, Associate Engineer, G. Brooks Earnest, W. A. Snyder, W. J. Hotkie and staff.
(e) The District Engineer, U. S. Engineer Office, Zanesville, Ohio.
(f) To determine performance of proposed design, and to obtain supporting data for improvements and operation.
(g) 1:35 scale model of side channel spillway, revised to straight overflow, 3 gate intake structure and stilling basin.
(h) Completed: data submitted in report to Major J. D. Arthur, Jr., District Engineer, under date of May 16, 1935.
(i) Information concerning tests on this project may be had through the District Engineer, U. S. Engineer Office, Zanesville, Ohio. Abstract in this bulletin.

....

(438)(a) PLEASANT HILL DAM ON CLEAR FORK, MOHICAN RIVER NEAR PERRYSVILLE, OHIO, MUSKINGUM WATERSHED PROJECT.
(b) U. S. Engineer Department, Zanesville District.
(c) Laboratory investigation on a model dam.
(d) Professor George E. Barnes, J. G. Jobes, Associate Engineer, G. Brooks Earnest, W. A. Snyder, W. J. Hotkie and Staff.
(e) The District Engineer, U. S. Engineer Office, Zanesville, Ohio.
(f) To determine proper hydraulic features of outlet works, spillway, spillway channel, and stilling basin.
(g) Constructed 1:50 scale model of outlet portal and stilling basin only. Constructed 1:30 scale model of intake tower, morning glory spillway, tunnels, outlet portal, stilling basin, and outlet channel. The 1:30 scale subsequently changed to 1:28.5, to reduce linear dimensions by 5%.
(h) Completed: data submitted in report to Major J. D. Arthur, Jr., District Engineer, under date of May 24, 1935.
(i) Information concerning tests on this project may be had through the District Engineer, U. S. Engineer Office, Zanesville, Ohio. Abstract in this bulletin.

....

(439)(a) GRIT CHAMBER, ONE UNIT OF FOUR, WARD'S ISLAND PROJECT, CITY OF N.Y.
(b) Warner Hydraulic Laboratory, Case School of Applied Science.
(c) Undergraduate thesis and research by staff.
(d) Professor George E. Barnes, A. D. Horkan, E. J. Leuty, staff.
(e) Professor George E. Barnes.
(f) To verify experimentally design features of outlet to tunnel shaft.
(g) 1:6 scale model of grit chamber with constricted outlet, hydraulic gradientfixed by critical depth at point of entrance to shaft.
(h) Undergraduate thesis completed. Further measurements being taken to show backwater effect from high water level in tunnel.

....

(440)(a) VENTURI FLUME.
(b) Warner Hydraulics Laboratory, Case School of Applied Science.
(c) Thesis for Master's Degree.
(d) H. J. Hotkie, under direction of Professor George E. Barnes.
(e) Professor George E. Barnes.
(f) To determine flow as a function of differential and absolute depths.
(g) Flume 18 inches wide and throat section 6 inches wide, using a flow up to 5 cfs.
(h) Construction of flume completed and measurements in progress.

....

(441)(a) SELF-PRIMING CENTRIFUGAL PUMP.
(b) Commercial organization.
(c) To secure data for claims and performance.
(d) Professor George E. Barnes.
(e) Professor George E. Barnes.
(f) To study flow conditions in the interior of the pump.
(g) Special pump constructed with transparent material.
(h) Installation under way, no measurements.

....

CORNELL UNIVERSITY.

(442)(a) DISCHARGE FROM LEVEL CIRCULAR PIPES FLOWING PARTLY FULL AT EXIT.
(b) Graduate (Master's) thesis.
(c) Scientific research.
(d) John Shelford.
(e) Professor E. W. Schoder.
(f) Comparison with other investigators on law connecting diameter, terminal depth, and discharge; also to find effect of degree of roughness of pipe.
(g) Measurements by point gage to top surface of issuing stream, with volumetric measurements of discharge. Some measurements to delineate the draw-down curve in the 3-inch brass pipe. Old steel pipes 2, 3, 4, 6, and 8 inch; brass pipes 2, 3 and 5 inch diameter.
(h) Thesis completed June, 1935.

....

(443)(a) FLOW AND PRESSURES OF WATER BENEATH DAMS ON EARTH FOUNDATION BY HYDRO-ELECTRIC ANALOGY.
(b) Graduate (Master's) thesis.
(c) Scientific research.
(d) Lieut. R. C. Brown.
(e) Professor S. C. Hollister.
(g) Shallow tray, cross-sectioned mirror bottom, ear phone, and loud speaker indicators for points on balanced circuits. A considerable variety of shapes of dams, and of locations, depths, and shapes of core walls were investigated.
(h) Thesis completed June, 1935.

....

HARVARD UNIVERSITY.

(106)(a) HYDRAULICS OF FLOW OF WATER THROUGH SAND.
(b) Research in water supply and purification.
(c) Departmental research.
(d) G. M. Fair and L. P. Hatch.
(e) Professor G. M. Fair.
(f) Rational formulation of flow of clean water through clean sand and evaluation of factors controlling flow.
(g) Laboratory studies conducted on small-size tubes containing beds of different structure.
(h) Continuing research. Results being worked up for publication.

....

HORTON HYDRAULIC AND HYDROLOGIC LABORATORY.

(290)(a) VELOCITY DISTRIBUTION IN STREAM CHANNELS.
(b) Scientific research.
(c) Scientific research.
(d) Robert E. Horton, C. W. Force and Laboratory staff.
(e) Robert E. Horton.
(f)
(g) Investigation comprises two parts: (1) A mathematical investigation of the form of velocity curves in open channels called for by the Manning formula; (2) An analysis and study of several hundred vertic velocity curves obtained in natural river channels, with a view to comparing the actual and theoretical curves.
(h) Investigation nearly completed and publication expected with a few months. See abstract in Bulletin III-1.

....

(291)(a) BACK-WATER BY THE MANNING FORMULA.
(b) Scientific research.
(c) Scientific research.
(d) Robert E. Horton and Laboratory staff.
(e) Robert E. Horton.
(f) Improvement in methods of analysis of problems of non-uniform flow.
(g) An integral of the back-water function in terms of the Manning formula has been obtained and tables of back-water functions have been computed therefrom for rectangular channels. It is believed that the method has important advantages because of the fact that where, as is ordinarily the case, back-water calculations are based on the Chezy formula, with a constant coefficient, serious errors are involved when the depth varies because the coefficient is itself a function of the depth.
(h) Investigation completed but results not yet written up in form for publication.

....

(292)(a) DISPERSION CURVES OF MANNING'S COEFFICIENT OF ROUGHNESS.
(b) Scientific research.
(c) Scientific research.
(d) Robert E. Horton and Laboratory staff.
(e) Robert E. Horton.
(f) The purpose is to provide a means of presentation of experimental values of the coefficient of roughness $\underline{n}$ in such a manner that the percentage of cases in which the observed coefficient has been found to be greater or less than a given value can at once be determined, thus leading to a more direct and certain method of selection by judgment of values of the coefficient of roughness applicable to a given case.
(g) All available values of the coefficient $\underline{n}$ for certain particular types of channels have been collated and plotted in the form of frequency curves. The analysis does not, however, cover all types of channels and covers only a limited number of classes of pipe surface.
(h) Investigation completed but results not yet written up in form for publication.

....

(293)(a) FLOOD WAVES SUBJECT TO FRICTION CONTROL.
(b) Scientific research.
(c) Scientific research.
(d) Robert E. Horton and laboratory staff.
(e) Robert E. Horton.
(f) To provide a basis for practical determination of the crest velocity and change of form of natural flood waves in large rivers.
(g) This research relates to the theoretical aspects of the subject. It is founded on an experimental investigation conducted some years ago at the same laboratory, using a slope table 120 feet in length, for the purpose of determining experimental forms of flood wave crests. The experimental research was conducted in part for the Sanitary District of Chicago. The present research relates mainly to the analysis of the results and is predicated on the idea that the movement of a flood wave in rivers is not, on the one hand amenable purely to momentum control, like waves in still water; neither is it, on the other hand, subject solely to friction control, as in the case of non-uniform flow in channels.
(h) Experimental investigation completed; theoretical investigation in progress. Suggestions are desired from other laboratories interested in this same problem.
See Abstract in Bulletin III-1.

....

(294)(a) RELATION OF CARRYING CAPACITY OF CAST IRON PIPE CONDUITS TO AGE IN SERVICE.
(b) Scientific research.
(c) Scientific research.
(d) Robert E. Horton.
(e) Robert E. Horton.
(f) Contribution to knowledge of the variation with age of the carrying capacity of water supply conduits and distribution mains.
(g) This investigation comprises mainly an analysis of continuous records covering five periods averaging one to three years each of variation in discharge coefficient with length of time in service since cleaning of a 24-inch water supply conduit at Utica, N. Y. It is shown that in this case the carrying capacity after cleaning decreases as an inverse exponential function of the time in service but does not approach zero as a limiting value. Causes of this are discussed and a comparison is made with other experimental data on the decrease in carrying capacity of pipe with age in service.

....

(385)(a) SURFACE RUNOFF PHENOMENA.
(b) Scientific research.
(c) Scientific research.
(d) Robert E. Horton and laboratory staff.
(e) Robert E. Horton.
(f) To determine (1) the law governing depth and velocity of overland or sheet flow under natural conditions; (2) to provide a means of analyzing the hydrograph into its various component elements, including surface runoff, infiltration, accretion to soil moisture and ground-water flow; also to determine depth of surface detention during runoff, phenomena of surface runoff, amount of channel storage following surface runoff, and law governing depletion of channel storage.

....

(336)(a) WIND VELOCITY NEAR THE GROUND.
(b) Scientific research.
(c) Scientific research.
(d) Robert E. Horton and laboratory staff.
(e) Robert E. Horton.
(f) Scientific research.
(g) Records of wind velocity 1 foot above ground at about sixty stations in the United States have been compared with measured wind velocities at nearby U.S. Weather Bureau Stations at various heights up to 200 feet above ground and these results compared with existing formulas of Stevenson, Hellman and others and with their experimental data.
(i) Comparison is also made between the law governing wind velocity distribution and that of water in a wide stream channel for turbulent flow conditions. Consideration is also given to the conditions under which air flow over the ground surface is laminar. See Bulletin III-2 for conclusions reached.

....

UNIVERSITY OF ILLINOIS.

(300)(a) MEASURING THE FLOW THROUGH A PIPE LINE BY MEANS OF DIFFERENCE OF HEAD BETWEEN OUTSIDE AND INSIDE OF A BEND.
(b) Research.
(c) Laboratory problem.
(d) W. M. Lansford.
(e) Professor M. L. Enger.
(f) To investigate the use of an elbow in a pipe line as a flow meter.
(h) Tests have been made on 2-in., 4-in., and 8-in. short-turn elbows. A paper entitled "Use of an Elbow in a Pipe Line as a Means of Measuring the Flow of Water," by W. M. Lansford, was published in the April 1934 Bulletin of the Associated State Engineering Societies. Further results of this investigation are given by Mr. Lansford in his discussion, published in the November, 1934, Proceedings and in Transactions, Volume 100, of the American Society of Civil Engineers, of a paper by David L. Yarnell and Floyd A. Nagler entitled "Flow of Water Around Bends in Pipes." This investigation is being continued. Tests are being made on a 6-in. elbow having an 8 in. to 6 in. reducing section before and a 6 in. to 8 in. expanding section after the bend.
(i) The work was begun as a result of a suggestion made by the late Professor Nagler of the Iowa Institute of Hydraulic Research. The difference in head between the outside and inside of a given bend is a constant times the velocity head in the pipe for velocities exceeding about 1 ft. per sec.

....

(301)(a) STUDY OF THE FLOW OF WATER IN A CIRCULAR GLASS PIPE BY THE USE OF MOTION PICTURES.

(b) Scientific research.

(c) Laboratory project.

(d) Edgar E. Ambrosius, John C. Reed.

(e) Professor M. L. Enger.

(f) To secure information relative to the characteristics of flow in circular conduits.

(g) Fine drops of an insoluble liquid (carbon tetrachloride and benzene) of the same density as water, in suspension in water flowing in a 1-3/4 inch circular glass pipe, are photographed by a motion picture camera as they move through a thin, broad field intensely illuminated from the two sides of the pipe.

(h) A paper entitled (Study of the Flow of Water Through a Glass Pipe" by Edgar E. Ambrosius, John C. Reed, and Henry F. Irving, was presented before the 1934 Summer Meeting of the Aeronautic and Hydraulic Divisions, American Society of Mechanical Engineers, at Berkeley, California, and published by the George Reproduction Company, San Francisco, California.

This investigation is being continued with a more elaborate set-up and has some refinements not found on the old, such as maintaining constant head and a smooth belled entrance to the pipe in which the analysis is being made. The existing apparatus with its new and improved lighting equipment will permit the study of water velocities (using streak pictures) up to 4 fps.

Using this set-up, velocity profiles for both the laminar and turbulent flow regions have been determined. The average velocity as obtained from them checks within approximately 0.5 percent of the average velocity determined from calculations by weighing the water discharged. The maximum velocity profile determined was for a velocity of approximately 4 fps, which corresponds to a Reynolds number of about 46,600.

The loss of head, friction factor, Reynolds number relations have also been determined for this particular pipe.

(i) The pipe is of sufficient length, 40 ft, made up of two 20 ft sections, to insure a complete normal velocity distribution at low velocities. By the use of streak pictures (time exposures) it is anticipated that some information regarding mixing distances, and related phenomena encountered in turbulent flow may be obtained.

....

IOWA INSTITUTE OF HYDRAULIC RESEARCH.

(109)(a) STUDY TO IMPROVE HYDRAULIC SYSTEM OF NAVIGATION LOCKS, GENERAL MODEL.

(b) Corps of Engineers, U.S.A.

(c) Institute project and graduate thesis.

(d) U.S.Engineer Department Staff.

(e) Martin E. Nelson, Associate Engineer.

(f) To eliminate as many as possible of the features now found to be unsatisfactory in river navigation locks and to increase the efficiency of the hydraulic systems of such locks.

(g) A typical barge lock was constructed 1/15 full size and has subsequently been altered to fit requirements developed by the tests. The model reproduces the complete hydraulic system of a lock.

(h) While a report on the tests made to date is in preparation, an investigation has been in progress of methods of measuring pressures in prototype locks.

....

(215)(a) MISSISSIPPI RIVER, DAM No. 20, STILLING BASIN DESIGN.
(b) Corps of Engineers, U S.A., Rock Island District.
(c) Institute project.
(d) U.S. Engineer Department Staff.
(e) Martin E. Nelson, Associate Engineer.
(f) To determine (1) general criteria for design of stilling basins for this and other low-head dams on erodible foundations, (2) discharge coefficients for tainter and roller gates, and (3) a schedule of operation at Dam No. 20.
(g) Tests were made on a model of a single tainter gate built 1/20th full size and on a model of a single roller gate built 1/30th full size.
(h) Additional tests have been run to supplement the calibration data.

....

(216)(a) MISSISSIPPI RIVER, LOCK & DAM NO. 5.
(b) Corps of Engineers, U.S.A., St. Paul District.
(c) Institute project.
(d) U.S. Engineer Department Staff.
(e) Martin E. Nelson, Associate Engineer.
(f) To determine (1) possible erosion of sand dam adjacent to spillways, (2) currents at the locks, (3) backwater caused by the dam, (4) the effectiveness of auxiliary spillways over the sand dam in reducing flood backwater, (5) certain specific effects of a freshet which damaged the construction railway in April, 1934, and (6) indicate possible damages to a railway fill along the right bank. In addition, an investigation was made to discover whether a model of this type could be used to study silting.
(g) The tests are being made in a fixed-bed model 1/500th full size in horizontal and 1/100th full size in vertical dimensions. Model water surface profiles were made to conform to open river profiles by roughening the main channel. Timber was simulated by scattered crushed rock. The "silt" found most satisfactory for use in the model was a commercial concrete admix (Barnsdall Admix). It was introduced into the inflow at the intake to the model.
(h) Tests have been completed and the model dismantled.
(i) It was found that silt problems could be worked out successfully in a model such as this.

....

(220)(a) HYDROSTATIC PRESSURES ON ROLLER GATES.
(b) Corps of Engineers, U.S.A.
(c) Institute project.
(d) U.S.Engineer Department Staff aided by Rock Island District Office.
(e) Martin E. Nelson, Associate Engineer.
(f) To determine distribution of hydrostatic pressure on model and full size roller gates under various conditions of operation.

(g) In addition to tests referred to in (f) tests were made on a section of submergible roller gate and sill 1/14th full size. Measurements were made at various submergences. Pressures on the up and down stream face of the lower roller apron and on the face of the sill were determined by means of water manometers.
(h) Tests have been completed but have not been analyzed.
(i) Possible vibration caused by reduced pressure on the gate apron was considered, but did not develop.

....

(306)(a) DISCHARGE COEFFICIENTS FOR SUBMERGED MODEL SPILLWAYS.
(d) F. T. Mavis, H. E. Howe, and W. J. Gallagher.
(e) Professor F. T. Mavis.
(h) Tests completed on 1:12 and 1:24 models of Iowa City dam. Further tests and observations in progress.

....

(309)(a) A STUDY OF THE FORMATION OF VORTICES ABOVE OUTLETS.
(d) Professor C. J. Posey and graduate students.
(e) Professor F. T. Mavis.
(f) To study the similarity of vortices.

....

(310)(a) STILLING POOLS FOR SPILLWAYS.
(c) Graduate thesis.
(d) H. C. Kuo.
(e) Professor F. T. Mavis.
(i) Continuation of studies previously reported.

....

(311)(a) TRANSPORTATION OF BOTTOM LOAD IN OPEN CHANNELS.
(c) Graduate Thesis.
(d) Te Yun Liu.
(e) Professor F. T. Mavis.
(f) Studies of capacity for traction.
(i) Progress report in Bulletin III-2, July 1, 1935, p 64.

....

(314)(a) LABORATORY STUDY OF GROUND WATER PROFILES.
(c) Graduate thesis.
(d) T. P. Tsui.
(e) Professor F. T. Mavis.

....

(315)(a) ANALYSIS OF PRECIPITATION AND FLOOD RECORDS FOR IOWA.
(d) F. T. Mavis and Edward Soucek.
(e) Professor F. T. Mavis.
(h) Frequency-intensity studies and flow duration tables completed.

....

(316)(a) HYDROLOGIC STUDIES - RALSTON CREEK WATERSHED.
(c) Cooperative project - U.S.Dept. of Agriculture and U.S.Geological Survey.
(e) Professor F. T. Mavis.
(h) Continuous records, since 1924, of precipitation, runoff, ground water levels, and cover. Drainage area of 3 sq mi of rolling agricultural land near east city limits of Iowa City.

....

(317)(a) COOPERATIVE STREAM GAGING IN IOWA.
(c) Cooperative project - U. S. Geological Survey.
(d) R. G. Kasel and Staff.
(e) Professor F. T. Mavis.
(h) Stream gaging stations are maintained cooperatively at stations on major watersheds in Iowa. Report on Stream Flow Records in Iowa 1873-1932 was prepared cooperatively by U. S. Geological Survey, Iowa Institute of Hydraulic Research, and Iowa State Planning Board, and published by the Iowa State Planning Board.

....

(318)(a) HYDRAULICS OF SAND FILTERS.
(d) Professor E. L. Waterman and graduate students.
(e) Professor F. T. Mavis.
(f) To study the hydraulic characteristics of filter sands in tubular sections of a filter.
(h) Second series of tests.

....

(387)(a) KANAWHA RIVER, WINFIELD DAM, GENERAL MODEL.
(b) Corps of Engineers, U.S.A., Huntington District.
(c) Institute project.
(d) U. S. Engineer Department Staff.
(e) Martin E. Nelson, Associate Engineer.
(f) To determine (1) swell head caused by project structures, with and without backwater from the Ohio River, (2) the effects in the lower lock approach of operation of the power-house, roller gates, and flap-crest gates, (3) effectiveness of ports in the upper guard wall in eliminating the draw around the nose of the wall.
(g) Tests are being made in a fixed bed model 1/125th full size. The model covers a 7300-ft reach of river with the project structures at about mid-point.
(h) Tests are complete but data have not been analyzed.

....

(388)(a) KANAWHA RIVER, WINFIELD DAM, STILLING BASIN MODEL.
(b) Corps of Engineers, U.S.A., Huntington District.
(c) Institute project.
(d) U. S. Engineer Department Staff.
(e) Martin E. Nelson, Associate Engineer.
(f) To supply the following information: (1) best shape and dimensions of sill for a standard-type roller gate; (2) best shape and dimensions of sill for a flap-type roller gate for over and under discharge; (3) dimensions and arrangement of a stilling basin for the dam; and (4) shape and size of roller gate pier noses and tails.
(g) Originally, tests were run on one roller gate and its supporting piers. This model was 1/46.12th full size. Additional tests were made on sectional models 1/20th full size. The original study covered stilling basin design, while the later tests were to study pressures on the sill faces.
(h) Tests are complete but have not been analyzed.

....

(389)(a) MISSISSIPPI R., DAM NO. 7, ONALASKA SPILLWAY.
(b) Corps of Engineers, U.S.A., St. Paul District.
(c) Institute project.
(d) U. S. Engineer Department Staff.
(e) Martin E. Nelson, Associate Engineer.
(f) To investigate the effectiveness of stilling basin designed for this combination overfalland culvert spillway and to develop improvements if indicated.
(g) Additional tests were made on models 1/16th full size representing 40 feet of spillway and containing two culverts. Calibrations were made of two types of partitioned culverts.
(h) Tests have been suspended.

....

(390)(a) MISSISSIPPI RIVER, LOCK & DAM No. 11.
(b) Corps of Engineers, U.S.A., Rock Island District.
(c) Institute project.
(d) U.S.Engineer Department Staff.
(e) Martin E. Nelson, Associate Engineer.
(f) To provide information on a layout for the spillways of this navigation dam which would cause least damage to a highway bridge approach fill below the structures.
(g) Tests are run in a distorted model with a fixed bed, except for a reach directly below the model dam which is movable bed. Horizontal dimensions are 1/200th full size and vertical dimensions are 1/80th full size.
(h) Machine work on an aluminum model of the dam is in progress.

....

(393)(a) ROLLER GATE COEFFICIENTS. (RI).
(b) Corps of Engineers, U.S.A., Rock Island District.
(c) Institute project.
(d) U. S. Engineer Department Staff.
(e) Martin E. Nelson, Associate Engineer.
(f) To determine discharge coefficients for an 80 by 20-foot roller gate and to determine quantitatively the effect of end contraction caused by pier noses.
(g) Investigations will be carried out on a model of three roller gates 1/18th full size. Calibrations will be made for a full range of gate openings and stages in upper and lower pools.
(h) Tests are in progress.

....

(394)(a) ROLLER GATE STILLING BASINS.
(b) Corps of Engineers, U.S.A., Rock Island District.
(c) Institute project.
(d) U. S. Engineer Department Staff.
(e) Martin E. Nelson, Associate Engineer.
(f) To obtain a stilling basin adequate to protect the river bed from the large discharges required to pass ice under the roller gates of Upper Mississippi River dams built on erodible foundations.

(f)- continued - Also to design an apron for a submergible gate which will accomplish the same purpose.
(g) A model of three 80 by 20 ft roller gates 1/18th full size is provided for this study. Approximately 50 feet of sand bed 2 ft deep is provided to indicate relative effectiveness of expedients tested.
(h) Tests are now in progress to determine the tailwater stages required at different gate openings to drown out the hydraulic jump.

....

(395)(a) SUBMERGIBLE TAINTER GATE.
(b) Corps of Engineers, U.S.A., Rock Island District.
(c) Institute project.
(d) U. S. Engineer Department Staff.
(e) Martin E. Nelson, Associate Engineer.
(f) To determine whether or not a gate of this type is feasible.
(g) A model of a 60 by 20-ft tainter gate, submergible to a depth of 8 ft, and appurtenant structures have been built 1/28.87th full size in a glass-sided flume. The investigation will cover: (1) water loads on the gate, (2) characteristics of flow over and under the gate, (3) discharge capacity of the gate, and (4) stilling basin design.
(h) A complete calibration of the gate is in progress. Tests cover both orifice and overfall conditions.

....

(397)(a) WHITEWATER RIVER SILTING STUDY.
(b) Corps of Engineers, U.S.A., St. Paul District.
(c) Institute project.
(d) U. S. Engineer Department staff.
(e) Martin E. Nelson, Associate Engineer.
(f) To investigate the effect upon deposition of silt at certain critical sections of the Whitewater River when it becomes affected by backwater from Mississippi River Dam No. 5.
(g) A fixed bed model 1/100th full size in vertical and 1/600th full size in horizontal dimensions was constructed of portland cement concrete for this study. It simulates the Whitewater River valley for a distance of about 10 miles upstream from the confluence of the Whitewater and Mississippi Rivers and the Mississippi River channel from a point above the town of Weaver to Minneiska, Minnesota. A 90° V-notch weir supplies water for Mississippi River flows and a small 30° V-notch measures flow in the Whitewater "Silt", represented by Barnsdall Admix, is introduced in the Whitewater inflow.
(i) Very satisfactory checks have been obtained between model and prototype.

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(444)(a) DRUM-TYPE SUBMERGIBLE TAINTER GATE PRESSURES.
(b) Corps of Engineers, U. S. A., Rock Island District.
(c) Institute project.
(d) U. S. Engineer Department Staff supplemented by personnel from the Rock Island Office.
(e) Martin E. Nelson, Associate Engineer.
(f) To determine pressure on and near the crest of a drum-type tainter gate when fully submerged and to investigate possible vibration caused by reduced pressure on the downstream face.
(g) Tests were run on a model 1/4th the size of a drum-type submergible tainter gate. However, only the top drum and a portion of the upstream and downstream face plates was represented. The model was installed in a flume into which river flow was passed. Pressures were measured by means of piezometers, installed in the face plates. Vibration studies were made with the model supported on rubber mountings.
(h) Tests are complete.
(i) Reduction in pressure on the crest of the gate was not serious. No vibration could be detected.

....

(445)(a) MISSISSIPPI RIVER, DAM NO. 26, COFFERDAMS.
(b) Corps of Engineers, U.S.A., St. Louis District.
(c) Institute project.
(d) U.S. Engineer Department Staff.
(e) Martin E. Nelson, Associate Engineer.
(f) To determine the effect of channel restriction during construction upon protective works designed for the auxiliary lock and to measure the backwater caused by various cofferdams.
(g) A movable-bed, distorted model of a short reach of river including the site of Dam No. 26 and bridges downstream from it was built for this study. Various expedients suggested to prevent scour at critical points around different cofferdams and the locks were tried out.
(h) Tests are complete.

....

(446)(a) ROLLER GATE COEFFICIENTS (St.P.).
(b) Corps of Engineers, U.S.A., St. Paul, Minn.
(c) Institute project.
(d) U.S.Engineer Department staff.
(e) Martin E. Nelson, Associate Engineer.
(f) To determine discharge coefficients for gates in Mississippi River Dams No. 5, 5A and B.
(h) A model is under construction which will be made of aluminum castings machined to 1/38th the size of the prototype. It will simulate a single rollergate and its supporting piers.

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(447)(a) TAINTER GATE COEFFICIENTS.
(b) Corps of Engineers, U.S.A., St. Paul District.
(c) Institute project.
(d) U.S.Engineer Department Staff.
(e) Martin E. Nelson, Associate Engineer,
(h) Model construction has not been started.
(i) This is a companion study to Project (446).

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(448)(a) WEEP HOLES.
(b) Corps of Engineers, U.S.A., St. Paul District.
(c) Institute project.
(d) U. S. Engineer Department Staff.
(e) Martin E. Nelson, Associate Engineer.
(f) To determine the gradient required to "boil" the gravel in weep holes 4 and 10 in. in diameter and 1.5 and 4.0 ft deep.
(g) An apparatus was set up in which metal pipes representing the desired weep holes to full scale were installed and subjected to various heads of water. The gradients through the weep holes were measured by drops in water pressures between piezometers near the lower and near the upper ends. The rate of flow was measured over a V-notch weir.
(h) Tests are complete.

....

(449)(a) HYDRAULIC CHARACTERISTICS OF QUARTER-TURN DRAFT TUBES.
(c) Graduate thesis.
(d) Professor C. A. Mockmore (Oregon State College).
(e) Professor F. T Mavis.
(f) Laboratory tests of transparent bends and draft tube models. Analysis of data.
(h) Completed and being prepared for publication.

....

(450)(a) IMPOUNDING RESERVOIR REQUIREMENTS IN IOWA AND MIDDLE WEST.
(d) Professor E. L. Waterman, Prof. F. T. Mavis, and Edward Soucek.
(e) Professor F. T. Mavis.
(f) Analysis of hydrologic data to determine reservoir capacities required for municipal water supplies obtained from small watersheds. Comparison with observations of existing reservoirs during 1933-34 drouth.
(h) Completed.

....

(451)(a) HYDRAULICS OF THE CURTIS BEND ON THE IOWA RIVER NEAR IOWA CITY.
(c) Graduate thesis.
(d) W. D. Smith and George D. Beeler.
(e) Professor F. T. Mavis.
(f) Correlation of field and laboratory data.

....

(452)(a) COEFFICIENTS OF DISCHARGE FOR TAINTER GATES.
(c) Graduate thesis.
(d) Professor J. W. Howe and Hoy D. Davis.
(e) Professor F. T. Mavis.
(h) Continuation of tests previously reported.

....

(453)(a) A STUDY OF MODEL SPUR DIKES.
(c) Graduate thesis.
(d) Pei-su Hsing.
(e) Professor F. T. Mavis.

....

(454)(a) DISTRIBUTION OF BED LOAD IN BRANCH CHANNELS.
(c) Graduate thesis.
(d) Chuan-Ching Hsu.
(e) Professor F. T. Mavis.

....

(455)(a) FUNCTIONAL DESIGN OF FLOOD CONTROL RESERVOIRS.
(c) Graduate thesis.
(d) Professor C. J. Posey and Fu-Te I.
(e) Professor F. T. Mavis.

....

(456)(a) THE HYDROMECHANICS OF EXPANDING CHANNELS.
(c) Graduate thesis.
(d) Carl E. Kindsvater.
(e) Professor F. T. Mavis.

....

(457)(a) THE TECHNIQUE OF THE PHOTOGRAPHIC DETERMINATION OF THE VELOCITIES OF WATER IN CLOSED CHANNELS.
(b) Institute of Hydraulic Research.
(c) Independent rèsearch.
(d) Dr. A. Lutsch, L. J. Hooper.
(e) Professor F. T. Mavis.
(f) To develop a technique for measuring velocities without introducing instruments into the stream.
(g) Preliminary tests using different floating particles have been made and results have been compared with measured rates of flow.
(h) Additional tests in progress.

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LOUISIANA STATE UNIVERSITY AND AGRICULTURAL AND MECHANICAL COLLEGE.

(28) (a) HYDROLOGICAL STUDY OF CITY PARK LAKE DRAINAGE AREA.
(b) Cooperative between the U. S. Geological Survey and the College of Engineering, Louisiana State University.
(c) General scientific research.
(d) Dr. Glen N. Cox and Assistants.
(e) Dr. Glen N. Cox.

(f) Study of rainfall, runoff and evaporation.
(g) The rainfall is measured in five standard cans and a Ferguson Weighing Recording Rain Gage, placed at various points over the 507 acre drainage area. The control is a concrete weir. An attempt will be made at arriving at the evaporation from the lake by knowing the amount of water that is being turned into the lake during dry periods and the amount that is being discharged.
(h) Records have been taken since April 1, 1933.

....

(224)(a) FACTORS AFFECTING THE EVAPORATION FROM A LAND PAN.
(b) Cooperative between the U.S. Geological Survey and the College of Engineering, Louisiana State University.
(c) General scientific research.
(d) Dr. Glen N. Cox and assistants.
(e) Dr. Glen N. Cox.
(f) To determine the effect of the various meteorological factors on evaporation.
(g) Records of evaporation are taken on a standard U. S. Weather Bureau Land Pan, and meteorological data are obtained from a nearby station maintained by the Geology Department of the University.
(h) Records have been taken since June 1, 1933.

....

(225)(a) COMPARISON OF EVAPORATION BETWEEN A LAND PAN AND A FLOATING PAN.
(b) Cooperative between the U. S. Geological Survey and the College of Engineering, Louisiana State University.
(c) General scientific research.
(d) Glen N. Cox and assistants.
(e) Dr. Glen N. Cox.
(f) Evident from title.
(g) A U.S. Geological Survey type floating pan is used, about which a barricade has been placed to reduce wave action. A recording thermometer and an anemometer have been installed so that a continuous record of lake temperatures and of wind movement may be obtained.
(h) Records have been taken since October, 1933.

....

(226)(a) TILE AND OPEN DITCH DRAINAGE.
(b) Cooperative between the U.S.Department of Agriculture and the College of Engineering, Louisiana State University.
(c) General scientific research.
(d) B. O. Childs and Dr. Glen N. Cox.
(e) B. O. Childs, Houma, La., or Dr. Glen N. Cox.
(f) Study of rainfall, runoff, monthly water requirements of sugar cane, water-holding power, etc.
(g) Records of rainfall have been kept on a tiled and on an open ditch area since October 1, 1930. All runoff is pumped and measured. Water-table readings have been taken at a large number of places daily.
(h) Using the four year record, a paper has been prepared for the open ditch area which shows the water requirements of sugar cane, the amount of water needed to raise the ground water level, and the amount of water needed to wet surface material without producing any effect on ground water. This paper has not been published to date.

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MICHIGAN STATE COLLEGE, DEPARTMENT OF CIVIL ENGINEERING.

(364)(a) INVESTIGATION OF HEAD LOSSES IN SMALL FITTINGS.
(b) Student thesis.
(c) As per title above.
(d) C. F. Clark and J. C. Erkfitz.
(e) Correspondent: Frank R. Theroux.
(f) As per title.
(g) Method and scope: Combination of four fittings of various kinds as 90 degree ells, tees, etc. in 2 inch and 1 inch diameters. Velocitie of 2 to 20 feet per second.
(h) Preliminary report as thesis by the authors completed June 1, 1935.

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MASSACHUSETTS INSTITUTE OF TECHNOLOGY, DEPT. OF CIVIL AND SANITARY ENGINEERING

(321)(a) EXPERIMENTAL INVESTIGATION OF THE TRANSPORTATION OF SAND BY RUNNING WATER.
(b) River Hydraulic Laboratory, M.I.T.
(c) Graduate research for Master's degree.
(d) S. Chyn.
(e) Professor K. C. Reynolds.
(f) To determine the relationship between the transportation of the sandy bed of a miniature river and the grain size composition of the sand forming the bed.
(g) Synthetic sands of various sand moduli and mean grain diameters will be used.
(h) Thesis submitted October, 1935, "An Experimental Study of the Sand Transporting Capacity of Flowing Water on a Sandy Bed and the Effect of the Composition of the Sand."

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(322)(a) EXPERIMENTAL DETERMINATION OF HYDRAULIC CHARACTERISTICS OF WATER CLOSET BOWLS.
(b) Massachusetts State Association of Master Plumbers and Sanitary Engineering Laboratory, M.I.T.
(c) Research for benefit of plumbing industry.
(d) Professor Thomas R. Camp, E. C. Roche, R. B. Thompson, Gerald Putnam.
(e) Professor Thomas R. Camp.
(f) To develop method of "rating" water closet bowls which will show their minimum requirements as to total quantity and rate of supply for an adequate flush.
(g) Rim and jet calibrated as orifices separately and operating together from which orifice constants are computed. Position of water surface in bowl observed with steady siphon action and steady weir action for various rates of flow through bowl. Minimum rate of flow for steady siphon action observed. Time observed for various constant rates of flush. From these data, rate of flush and amount of water for "safe economic flush" are established. Trial flushes are made from which rate curves of bowl discharge are measured.
(h) Report to be published sometime during the coming year.

....

(361)(a) EXPERIMENTAL AND THEORETICAL STUDY OF THE HYDRAULICS OF FLUSHING DEVICES FOR WATER CLOSET BOWLS.

(b) Massachusetts State Association of Master Plumbers and Sanitary Engineering Laboratory, M.I.T.

(c) Research for plumbing industry.

(d) Professor Thomas R. Camp, E. C. Roche, R. B. Thompson, J. B. Drisko and G. Putnam.

(e) Professor Thomas R. Camp.

(f) To develop method of calibrating flush valves and tanks which will show their discharge characteristics and pressure requirements.

(g) Hydraulic analysis of flush tanks is made. Flush valves are studied and classified, and a general hydraulic theory is developed for expressing pressure drop and rate of flush as a function of time during a flush. Individual flush valves are studied experimentally in an effort to evaluate the valve characteristics. Methods of adjusting flush valves to service conditions are described. A method of calibrating valves to facilitate selection and adjustment is recommended. Back-siphonage through flush valves and protective means are discussed.

(h) Report tobe published some time during the coming year.

....

(362)(a) MODEL OF CAPE COD CANAL AND APPROACHES.

(b) Colonel John J. Kingman, District Engineer, U. S. Engineer Office, Boston.

(c) Research in connection with proposed widening program for Cape Cod Canal.

(d) Professor K. C. Reynolds and staff.

(e) Professor K. C. Reynolds.

(f) To determine mean low water profile and other hydraulic features connected with design of enlarged canal with 500-foot bottom width and 40-foot depth.

(g) A distorted fixed bed model has been built of the Canal including the approach in Cape Cod Bay and both the present and proposed approaches in Buzzards Bay from Wings Neck. Horizontal scale 1:600, vertical scale 1:60, length of model 115 feet. The tides of the two bays are controlled by an electrically operated mechanism. Water surface elevations are electrically determined by using the water surface as one plate of a condenser.

(h) Tests under way.

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(363)(a) MODEL STUDY OF PROPOSED MOORING BASIN FOR CAPE COD CANAL.

(b) Colonel John J. Kingman, District Engineer, U.S. Engineer Office, Boston, Mass.

(c) Research in connection with proposed widening program for Cape Cod Canal.

(d) Professor K. C. Reynolds and staff.

(e) Professor K. C. Reynolds.

(f) To determine design of transition section between the proposed mooring basin, which is to be 2000 feet long and 3000 feet wide, and the main canal. The shape of this section - whether a series of tangents or a circular arc - governs the extent of an eddy which tend to cause deposition.

(g) Model scale 1:150. The position of the eddy is determined by dye. Its length as well as width is governed by the shape of the connection.
(h) Report submitted.

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MASSACHUSETTS INSTITUTE OF TECHNOLOGY, HYDRAULIC MACHINERY LABORATORY.

(36) (a) EXPERIMENTAL INVESTIGATION OF THE CAVITATION PHENOMENON.
(b) Massachusetts Institute of Technology.
(c) General research.
(d) H. Peters - B. G. Rightmire.
(e) Professor H. Peters.
(f) 1. Study of properties of the liquid which influences the severity of cavitation damage.
2. Study of the periodic nature of cavitation.
(g) for (f)(1) An aluminum sample is vibrated in various liquids at various temperature with an approximate frequency of 8000 cycles/sec and amplitude of about 0.01 mm. The loss of weight is used as a measure for the severity.
for (f)(2) Experimental work in a Venturi passage and theoretical work.
(h) Progress reports:
J. C. Hunsaker, Mechanical Engineering, April 1935. Volume 57, No. 4.
J. C. Hunsaker, A.S.M.E. October 1935, Volume 57, No. 7.
E. W. Spannhake, Thesis, Mass. Institute of Technology Library, "Theoretical Investigation of the Periodic Nature of Cavitation".

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(483)(a) I. INVESTIGATION OF ROTARY FLOW IN PIPE LINES.
II. INFLUENCE OF ROTATION UPON ORIFICE AND NOZZLE COEFFICIENTS.
(b) Massachusetts Institute of Technology.
(c) General study.
(d) Students.
(e) Professor H. Peters.
(h) In progress.
I. Thesis, 1934.
II. Thesis, 1935.

....

(484)(a) STUDY OF MIXING BETWEEN A JET OF FLUID OF VARIOUS DENSITIES AND A STILL FLUID.
(b) Massachusetts Institute of Technology.
(c) General study.
(d) J. Bicknell - H. Peters.
(e) Professor H. Peters.
(f) Study of turbulent mixing.
(g) Progress report at the annual meeting of the Institute of the Aeronautical Sciences, January, 1936.

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(485)(a) STUDY OF FLOW THROUGH RECTANGULAR CHANNELS.
(b) Massachusetts Institute of Technology.
(c) General study.
(d) Students.
(e) Professor H. Peters.
(f) Determination of frictional factors.
(g) Pressure measurements and velocity distribution.
(h) Just started.

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(486)(a) STUDY OF THE BOUNDARY LAYER ON SURFACES WITH PRESSURE GRADIENT.
(b) Massachusetts Institute of Technology and the National Advisory Committee for Aeronautics.
(d) H. Peters - J. Bicknell.
(e) H. Peters.
(f) Study of friction and of separation of laminar and turbulent flow.
(g) Airflow through a 2-dimensional Venturi passage.
(h) Just started.

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OHIO STATE UNIVERSITY.

(458)(a) CALIBRATION OF A VENTURI METER FOR A LARGE RANGE OF REYNOLDS NUMBERS.
(b) The Ohio State University Engineering Experiment Station.
(c) General engineering research.
(d) Professor S. R. Beitler.
(e) Professor S. R. Beitler.
(f) Further proof of the validity of the Reynolds Number theory to meters.
(g) A 1/2 x 3/4 inch Venturi is being calibrated with hot and cold water and with high accuracy head and quantity measurements to determine accurately the variation of coefficient with Reynolds number over a Reynolds number range of from 2,000 to 500,000.
(h) Test runs are in progress; they are expected to be completed in about six months.

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PACIFIC HYDROLOGIC LABORATORY.

(370)(a) EARTH DAM INVESTIGATIONS.
(b) 1. U.S.Indian Service.
2. Santa Clara Valley Water Conservation District.
3. California Water Service Company.
(c) Conducted as part of engineering research for design and selection of material for rolled-fill earth dams.
(d) Charles H. Lee.
(e) Charles H. Lee, Consulting Engineer, 58 Sutter St., San Francisco, California.
(f) Study of physical properties of soils as related to rolled-fill earth dam construction.

(g) Mechanical analysis by hydrometer method, shrinkage tests (Atterburg limits), microscope examination, specific gravity determinations, compaction tests, permeability of undisturbed compacted material, shear and compression tests.
(h) Completed.
(i) Partial results included in paper by Charles H. Lee entitled "Selecting Materials for Rolled Fill Earth Dams", presented at a meeting of the Irrigation Division, Am. Soc. Civil Engineers in Los Angeles, California, July 4, 1935. Short summary of paper published in Civil Engineering, September, 1935, p. 556, with comments by letter in October and November issues of Civil Engineering.

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PENNSYLVANIA STATE COLLEGE.

(137)(a) A STUDY OF VARIOUS TYPES AND KINDS OF STILLING DEVICES FOR USE IN CHANNELS OF APPROACH TO WEIRS AND FOR OTHER PURPOSES.
(b) The Pennsylvania State College.
(c) Research.
(d) Professors Elton D. Walker and H. K. Kistler.
(e) Either of above.
(f) The development of a standard stilling device, or possibly more than one device.
(g) Water is admitted to one end of a tank from a pipe, under such conditions as to produce a high velocity and considerable turbulence. The discharge is measured at the other end of the tank by means of a standard weir which has been calibrated. Velocity measurements are made at a number of points in a cross section about four feet downstream from the inlet both with and without any stilling devices in place. When stilling devices are tested, they are inserted about two feet below the inlet. Each device is tested with a number of different velocities, average velocities being determined by means of the weir readings and the cross section of the channel. We seek to relate the relative effectiveness of the various stilling devices to the magnitude and distribution of velocities in the cross section.
(h) Data covering a large number of experiments are being tabulated and studied, and a progress report in the form of a bulletin is under preparation.
(g) Further investigation that may be suggested by the results found will be undertaken as soon as the current preliminary studies are completed.

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UNIVERSITY OF PENNSYLVANIA.

(371)(a) INVESTIGATION OF THE INFLUENCE OF INSTALLATION ON THE COEFFICIENTS OF VENTURI METERS.
(b) Will be presented to the A.S.M.E. Fluid Meters Committee.
(c) This is an investigation to determine the limiting installation conditions for Venturi meters of high and low ratio.
(d) W. S. Pardoe, and a graduate class of three students.
(e) Professor W. S. Pardoe.
(f) Largely commercial.
(g) It involves at least twenty complete tests of each meter.

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PENNSYLVANIA WATER & POWER COMPANY.

(228)(a) RESISTANCE OF WELDING MATERIALS TO CAVITATION - HIGH HEAD TESTS AT HOLTWOOD.
(b) Pennsylvania Water & Power Company and Safe Harbor Water Power Corporation.
(c) Commercial research.
(d) J.M.Mousson and Assistants.
(e) C. F. Merriam.
(f) Determination of resistance of various materials to pitting. Selection of best materials and method of application for repairs to turbines damaged by action of cavitation. Determination of most suitable material for new turbine installations.
(g) Exposure of test plates to cavitation formed by a special weir profile under a head of 1100 ft. Materials to be tested include welded, sprayed, cast, forged, and rolled plates of various steels, bronzes and other alloys. Quantitative measurement of severity of damage is made by weighing specimens for amount of material lost. Correlation of results of these tests with analysis of chemical and physical properties.
(h) Sufficient information has been secured to select a material for prewelding of turbine blades combining corrosion resistance and machinability. Tests have indicated some correlation between Brinell hardness and resistance to pitting, although hardness alone is no infallible criterion.

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(229)(a) RESISTANCE OF MATERIALS TO CAVITATION, LOW HEAD TESTS AT SAFE HARBOR.
(b) Pennsylvania Water & Power Company and Safe Harbor Water Power Corporation.
(c) Commercial research.
(d) C. F. Merriam and assistants.
(e) C. F. Merriam.
(f) Determination of resistance to pitting of various materials and protective coatings, and study of nature of pitting by microscopic examination of damage.
(g) Exposure of test plates to cavitation formed in a rectangular venturi passage. Materials tested include various steels, cast iron, copper, lead, aluminum, rubber and rubber paints, and other protective paints.
(h) Active work on this project has been suspended although apparatus is held in readiness for further work. Although experiments show that with head available the damaging action was not sufficiently severe to give greatly accelerated results, nevertheless it was possible to watch the progress of pitting and get a clearer idea of the way in which the destruction takes place.

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(230)(a) TURBINE MODEL TESTS.
(b) Safe Harbor Water Power Corporation.
(c) Commercial testing.
(d) L. M. Davis and assistants.
(e) C. F. Merriam.
(f) Determination of the effect of alteration of the shapes of blades for a Kaplan turbine and study of efficiency and cavitation characteristics. of model runners.
(g) Efficiency and cavitation research on hydraulic turbines and commercial tests - Holtwood Hydraulic Laboratory.
(h) Much valuable information has been obtained. Practical methods of conducting cavitation tests have been developed and perfected. The laboratory is now being used for a number of commercial tests.

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PRINCETON UNIVERSITY.

(459)(a) THE SUBMERGED HYDRAULIC JUMP AND CALIBRATION OF A FIVE-INCH VENTURI METER.
(b) Graduate thesis.
(c) Laboratory research.
(d) Lt. Allen F. Clark, Jr., U.S.A.
(e) Professor Lewis F. Moody.
(f) The purpose was to compare the actual conditions in a "submerged" or "drowned" jump with a theoretical formula proposed by Professor Moody (see previous research by Lt. P.E.Ruestow, Report No. II - 1, Jan. 1, 1934, project (139) p. 19). This is a continuation of previous research taking advantage of improved apparatus. As an incidental feature, a volumetric calibration was made of a new 5 inch Venturi meter of special design, using a rounded entrance similar to a standard nozzle instead of the usual conical contraction; this meter then being used to measure the discharge in the primary apparatus.
(g) Water was discharged under a sluice into a 12 inch x 12 inch glass flume. Observations were made over the whole range of depths producing a free jump, covering both the direct and undular forms of jump, and were extended to include the conditions when the standing wave had rolled upstream to the sluice, submerging the stream flowing from under the sluice. The apparatus comprised a copper-lined tank discharging into a glass-sided rectangular open channel, with control weir at its downstream end, and a shifting trough and measuring tank for measuring the discharge and a venturi meter measuring the inflow.
(h) Venturi Meter: The meter was found to have excellent characteristics with a nearly uniform coefficient approaching 99 percent at high velocities.
Submerged discharge: Referring all elevations to a datum at the floor of the channel, and expressing each elevation as a fraction of the initial elevation H in the supply tank,

$$d'_1 = \frac{\text{depth of sluiceway}}{H};$$

$$d'_s = \frac{\text{depth at downstream face of sluice wall}}{H};$$

$$d'_2 = \frac{\text{downstream depth}}{H};$$

the formula investigated is:

$$d'_1 = \frac{1}{2}\left(d'_2 \pm \sqrt{d'_2 - d'_2\frac{(d'^2_2 - d'^2_s)}{(1-d'_s)}}\right)$$

A chart was constructed for the convenient solution of problems. It was concluded that except at low degrees of submergence the agreement between the observations and theory was good, and that in the usual problem, encountered in practice, straight application of the theory without any correction would be sufficiently accurate.

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(460)(a) INVESTIGATION OF THE CHARACTERISTICS OF THE BENTZEL VELOCITY TUBE.

(b) Graduate thesis.

(c) Laboratory research.

(d) Lt. M. L. Thomas, U.S.A.

(e) Professor Lewis F. Moody.

(f) To investigate the characteristics of a velocity-measuring instrument developed by Mr. C. E. Bentzel at the U.S.Waterways Experiment Station, Vicksburg. The work was done in the still-water rating tank, to find the effect of various velocities and various angles of obliquity of motion, as an indication of the probable bahavior in actual flow containing turbulence.

(g) The instrument was mounted on the rating car and tested through the available range of velocities and at various inclinations to the motion through the still water, using several floats in the meter tube for different velocity ranges. The angular results were compared with the cosine surve corresponding to correct resolution of the velocity.

(h) The instrument was found to be an excellent and useful device, particularly for the measurement of low velocities not otherwise easy to record. It was found to have characteristics similar to those of the Pitot tube, and to over-register slightly in oblique flow, requiring an estimated correction factor of the order of 98 percent for usual degrees of turbulence. Suggestions were made for modifications of the form of the resistance cap or entrance nozzle, for the purpose of improving its oblique flow characteristics.

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(461)(a) ANGULAR CHARACTERISTICS OF CURRENT METERS.
(b) Graduate thesis.
(c) Laboratory research.
(d) Lt. William R. Smith, Jr., U.S.A.
(e) Professor Lewis F. Moody.
(f) The purpose was to determine through still-water ratings the effect on different forms of meter of obliquely flowing water such as is encountered when a meter is used in the field owing to the turbulence existing in actual flow. Through a comparison of the results it was desired to discover the effect of various differences in meter design on the meter characteristics, with a view of pointing the way to the development of a more nearly "cosine-true" meter less subject to the effects of turbulence in the flow to be measured.
(g) (h) Two meters of the horizontal axis or axial-flow type were investigated, a Gurley barrel-type meter, and a Hoff meter having two forms of runner or propeller without shroud ring or guide cylinder. The meters were calibratedin the still water rating tank for both straight flow and a wide range of angles of obliquity to the motion of the car. The effects of form variations were analyzed and a modified form of meter proposed to minimize obliquity effects. It was found that the simple axial flow propeller, illustrated by the Hoff meter conforms to the usual characteristics of such meters, namely, a tendency to over-register in oblique flows; the meter,having a stationary cylindricalcowl or barrel surrounding the propeller, had an average effect of angularity which was very small, so that its average characteristics were good, but its curves were distinctly unsymmetrical, it being oppositely affected by right and left-hand horizontal obliquity. The average result was a slight tendency to over-register for small angles of obliquity. A modified design of meter was proposed as an improvement to meet various factors considered and to approach a characteristic having minimum over- or under-registry due to obliquity of flow.

....

(462)(a) CAVITATION RESEARCH.
(b) Experimental investigation.
(c) Laboratory experiments.
(d) Professors Lewis F. Moody and Alfred E. Sorenson.
(e) " " " " " " " "
(f) (g) See report published in Transactions, American Society of Mechanical Engineers, October, 1935, pp 425-428, presented at annual meeting A.S.M.E., December 3, 1935.

The object was to determine the critical point of cavitation, or cavitation limit, of water flowing in a closed system as caused by the formation of vapor-filled cavities in the system. The experiments were directed to determine the cavitation limit, at which cavitation begins, and not to ascertain the consequences of maintained cavitation.

The work was done on a small venturi meter. The results were found to be consistent with the cavitation principle and formula as now generally applied.

(h) Work is being continued with the same equipment, and a new and larger apparatus is being installed, equipped with a glass throat 2-1/2 inches in inside diameter to permit visual observations.

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PURDUE UNIVERSITY.

(47) (a) FLOW OF FLUIDS THROUGH CIRCULAR ORIFICES AND TRIANGULAR WEIRS.
(b) Purdue Engineering Experiment Station.
(c) General scientific research.
(d) F. W. Greve and student assistants.
(e) Professor F. W. Greve, School of Civil Engineering, West Lafayette, Indiana.
(f) To determine experimentally the effects of density, surface tension, temperature, and viscosity upon the discharge rate through small circular orifices and triangular weirs.
(g) No change has been made since the last semi-annual report.
(h) The work since the beginning of the present academic year has been confined entirely to computations involving: (1) discharge, velocity and contraction coefficients of the orifices; (2) discharge coefficients of the triangular weirs; (3) Reynolds number; and (4) coefficient of surface tension.
(i) Computations will be continued to determine what relation, if any, exists among the several physical properties of water and soap solutions in connection with the discharge through orifices and weirs. Experiments will be resumed whenever it is possible to procure sufficient oil for test purposes.

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S. MORGAN SMITH COMPANY.

(491)(a) KAPLAN TURBINE EFFICIENCY AND HORSE POWER TESTS.
(b) U. S. Engineer Office, Portland, Oregon, Bonneville Power Plant.
(c) Guarantee tests and research.
(d) R. Sahle, J. D. Scoville, Harold Ross for S. Morgan Smith Co., Howard L. Cooper for U.S.Engineer Office.
(e) Engineering Department, George A. Jessop, Chief Engineer.
(f) To determine the horse-power and efficiency of the full-size turbines in their permanent field setting. To select the most efficient design of setting. To get complete information so that the turbines can be most efficiently operated over the entire range of head from 30 to 65 feet. To determine the best blade and gate relationships under all heads, so that the control mechanism may be properly designed.
(g) An exact model was made of the full-size runner, its gate case, and part of the intake and draft tube, which had already been built by the Government. Two scroll cases and two draft tubes were made, each of which was tested, and the most efficient selected. In addition, various modifications were investigated. After the best combination of the various elements was determined the complete model of the entire hydraulic installation was used for each of the whole series of tests. The runner blades were carefully set and locked in a series of six positions or angles covering the full stroke. At each position a series of tests

was made with a sufficient number of gate openings, so that a curve can be drawn to determine the exact opening to produce maximum efficiency at the particular blade angle under test. After all the blade angles are tested, envelope curves are drawn showing the correct blade angle-gate opening relationship throughout the entire range of operation.

All of the final tests were conducted over a large range of speed to cover the required proportional speeds as determined by the field head conditions. Sufficient information was obtained to construct correct blade angle-gate opening curves for all heads under which the turbines will operate.

The power was measured by an Alden absorption dynamometer and precision beam scale, the head by differential float gauges, and the water by a weir. The distribution of the water at the draft tube outlet was determined.

(h) Tests are completed.

(i) The data selected are much more comprehensive than is practicable in a field test. In view of the short intake at Bonneville and the extremely large quantity of water involved, it is believed a more accurate determination of the efficiency can be made in the laboratory than in the field, even though a differential must be used to step up the laboratory efficiencies.

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(492)(a) KAPLAN TURBINE CAVITATION TESTS.

(b) U. S. Engineer Office, Portland, Oregon, Bonneville Power Plant.

(c) Research.

(d) R. Sahle, J. D. Scoville, Harold Ross for S. Morgan Smith Co., Howard L. Cooper, for U. S. Engineer Office; L.M.Davis and Staff of the Holtwood Testing Flume.

(e) Engineering Department, George A. Jessop, Chief Engineer.

(f) To determine the cavitation limits for the full size turbines in their field setting.

(g) The complete model of the entire hydraulic installation was used for all of the cavitation tests. Various runner blade settings were tested, but it was found not necessary to use the very low angles. The tests were run over a sufficient range of speed to cover the conditions at the plant. The tests were made by the usual method followed at the Holtwood laboratory, which have been described in papers published by the engineers in charge.

The data secured shows that there is much more safety against cavitation than had been predicted from former tests, a very substantial improvement having been obtained by careful designing. Sufficient information was obtained to permit the establishment of horse-power limits for the operation of the turbines under the various heads with a minimum of pitting.

All testing and computing was done in the Holtwood laboratory of the Pennsylvania Water & Power Co., including efficiency check tests. The data to be determined and the comprehensiveness of the tests was specified by the S. Morgan Smith Company and the U. S. Engineer Office.

The cavitation tests apply to the service unit, as well as to the large units. While the settings of the two sizes of Kaplan

turbines are not exactly homologous, the influence on cavitation is known to be very slight.

(h) Laboratory tests are completed.

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(493) (a) TESTS OF DRAFT TUBES FOR KAPLAN TURBINES.

(b) U.S.Engineer Office, Portland, Oregon, Bonneville Service Unit.

(c) Research.

(d) R. Sahle, J. D. Scoville, Harold Ross for S. Morgan Smith Co., Howard L. Cooper for U. S. Engineer Office.

(e) Engineering Department, George A. Jessop, Chief Engineer.

(f) To determine the influence on horse-power and efficiency of specially-designed draft tubes.

(g) The runner and gate case for the Bonneville 5,000 hp unit is the same design as for the 66,000 hp units. The efficiency and cavitation tests made for the large wheels therefore apply to the small one. The intake and scroll case are of an entirely different design, but sufficient tests had already been made to determine the influence of the supply passages. Owing to special conditions, it was necessary to use an unusual design for the draft tube. In order to secure the highest possible efficiency, it was considered advisable to make laboratory tests. Two different tubes were investigated. One was designed by Howard L. Cooper of the U. S. Engineer Office and one by the manufacturer. It was not necessary to make as complete tests as for the large units, but sufficient data were secured to cover the range of head. The setting of the service unit is such that an accurate field test can be made, and the guarantees are made on the basis of field results.

(h) The laboratory tests are completed.

(i) It is expected that a careful and comprehensive field test will be made for power and efficiency.

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STEVENS INSTITUTE OF TECHNOLOGY.

(378) (a) THE STUDY OF THE FORCES ACTING ON SAILING YACHTS IN ACTUAL SAILING ATTITUDES.

(c) General scientific research.

(d) Professor Kenneth S. M. Davidson.

(e) Professor Kenneth S. M. Davidson.

(f) To determine the longitudinal resistance of sailing yachts heeled over and moving with leeway as they do under actual sailing conditions.

(g) Observations taken on board ships to determine relation between sail forces, speeds and heeled angles. Scale models are towed in the attitudes determined from the full size observations.

(h) Sufficient results have been obtained to show that the method is sound.

(i) The project involves the towing of yacht models heeled over and with sufficient leeway to give the lateral force necessary to balance the sail force. It further involves the measurement of lateral forces while the model is moving longitudinally.

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THE TULANE UNIVERSITY OF LOUISIANA.

(463)(a) INVESTIGATION OF HYDRAULIC LOSSES AT PIPE ENTRANCES.

(c) Graduate research.

(d) J. K. Mayer.

(e) Professor W. B. Gregory.

(f) To determine the relationship between the entrance loss coefficient ($h'_e = K_e V^2/2g$) and Reynolds number R_e for various types of pipe entrances; viz., square-edged cylindrical pipes of various wall thickness, cone entrances of various lengths and angles, and bell-shaped entrances.

(g) Investigations were first carried out on model intakes made of 3/4 inch brass pipe having piezometer rings attached at various distances from the entrance and connected to a manometer for determining the pressures. Water was drawn through the intake by means of a centrifugal pump and discharged into a weighing tank in order to determine the rate of flow. The static head of water over the entrance was measured with a hook gage. Runs were made on each intake at various velocities within the limits of the apparatus. Work is now being done on a 4 inch brass pipe drawing waterfrom the laboratory storage channels and discharging into a calibrated 60° V-notch weir.

(h) The results to date may be summarized as follows:

Square-edged cylindrical entrances.

(1) The entrance coefficient seems to have a common value of about 0.25 at aReynolds number of 2000 for a large range of wall thicknesses.

(2) The coefficient increases as a fractional power of the Reynolds number from this point up to an R_e of about 50,000, the value of the exponent increasing as the wall thickness is decreased.

(3) The coefficient is practically independent of R for values above 50,000.

(4) The entrance coefficient is near its minimum value when the wall area is equal to the pipe area and further increase in wall thickness has little effect.

Conical entrances (19° Total Angle).

The entrance coefficient as determined includes the entrance loss plus the loss in the cone up to its point of attachment to the cylindrical pipe. The apparatus used limited the range of R_e in the cylindrical pipe to values ranging from 57,000 to 161,000.

(1) For cone lengths of six times the pipe diameter (6d) and above the coefficient increases as the first power of Reynolds number.

(2) For cone lengths of from 2d to 0 the coefficient is practically independent of the value of R_e.

(3) The entrance loss increases as the cone length is shortened.

(4) An annulus placed flush with the entrance decreased the loss somewhat.

(5) A cone truncated from 4d to 2d has about the same entrance loss as a right cone 1.5d long.

(i) Only one cone angle has been investigated to date and no work done on bell-shaped entrances. It is expected that these investigations will be completed and a thesis written early in 1936.

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(464)(a) TESTING OF MODEL SCREW AND CENTRIFUGAL PUMPS.

(c) Graduate research.

(d) W. P. Wallace and A. P. Texada, Jr.

(e) Professor W. B. Gregory.

(f) To carefully determine the characteristics of a 9 inch Wood screw pump and a 3 inch Wood trash pump under various conditions.

(g) The screw pump is a model of the 14 foot Wood screw pumps used in the drainage of New Orleans and was built by the New Orleans Sewerage and Water Board under the personal supervision of Mr. A. B. Wood. The pump is driven by a 9-speed induction motor mounted as a power dynamometer and discharges into a calibrated 60° V-notch weir. Heads are determined by manometers and altitude gages.

The trash pump is also driven by a motor mounted as a power dynamometer and discharges into the same V-notch weir.

(h) Installation of the screw pump has just been completed and only preliminary tests made to date.

Tests of the trash pump have proved quite satisfactory, showing a maximum pump efficiency of 60 percent at 202 gpm against a head of 21 ft when running at 1170 rpm.

....

(465)(a) DETERMINATION OF CHANNEL DISCHARGE BY CURRENT METER TRAVERSE.

(b) -

(c) Graduate research.

(d) W. P. Wallace and A. P. Texada, Jr.

(e) Professor W. B. Gregory.

(f) To check the discharge of a channel as determined by current meter traverses against that determined by calibrated weirs.

(g) Water is taken from the storage channels in the hydraulic laboratory floor and discharged into a skimmer weir tank by means of a 12 inch centrifugal pump. It then flows through a 2 ft suppressed and a 2 ft contracted weir in parallel and returns to the channel. Current meter traverses are made in the return channel leading to the pump intake. The weirs were first calibrated by deflecting the discharge into a weighing tank. The maximum pump discharge is about 8 cfs and the traverse section of the channel 3 ft wide with a normal depth of water of about 2 ft. Both Price and Hoff meters are used.

(h) The current meters have always indicated higher discharges than shown by the weirs and are now being sent to the National Bureau of Standards for rating.

The installation of turning blades (guides) in the 90° channel bend 27.5 ft upstream from the traverse station has improved the results somewhat. Baffling has shown very little effect.

A six-point traverse (3 horizontal stations at 2 depths) shows practically the same results as traverses using several times as many points.

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WEST VIRGINIA UNIVERSITY.

(50) (a) DISCHARGE THROUGH THIN PLATE ORIFICES IN PIPE LINES.
(b) Thesis for M.S.C.E. degree.
(c) General scientific research.
(d) A. E. McCaskey and H. W. Speiden.
(e) Professor H. W. Speiden, Dept. of Civil Engineering, West Virginia University, Morgantown, W. Va.
(f) To study the coefficients of various sizes of circular orifices in thin plates in pipe lines, with a view to the determination of the relations existing between the coefficients of large and small orifices by the principle of similarity.
(g) A series of orifices has been tested in 2 inch pipes of brass and wrought iron. The effect of pressure measurements at various points on the pipes has been studied. The present work is on a 4 inch pipe of wrought iron with orifice and piezometer dimensions similar to those in the earlier work.
(h) Experimental work is practically completed on this phase of the work and the thesis will be published in January, 1936.

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CARNEGIE INSTITUTE OF TECHNOLOGY.

(284) (a) CONSTRUCTION OF A MODEL OF THE ALLEGHENY-MONONGAHELA-UPPER OHIO RIVER SYSTEM FOR USE AS AN INTEGRATING MACHINE FOR SOLVING PROBLEMS OF FLOOD-WAVE MOVEMENTS IN THIS RIVER SYSTEM.
(b) Carnegie Institute of Technology.
(c) Pure research.
(d) H. A. Thomas and student assistants.
(e) Professor H. A. Thomas.
(f) To investigate the feasibility of obtaining accurate solutions of flood wave problems by using a special type of model channel as an integrating machine, and to apply this method to a study of various problems arising in connection with flood protection by proposed reservoirs in the Allegheny-Monongahela River basin.
(g) This model is about 80 feet long by 2 feet wide. It represents several hundred miles of the main river channels, all controlled tributaries below proposed reservoir sites, and numerous other tributaries. Vertical, longitudinal and transverse scales are unequal. Profiles and cross sections are reproduced to scale, but curves are not reproduced. Hydraulic friction effect is produced by transverse metal fins, designed to duplicate the prototype rating curves. The flood wave from each tributary is introduced from an individual tank with a float-controlled orifice designed to reproduce the prototype hydrograph. Maximum flood stages of about 7 inches in the main model channels are read with precision on inclined gages.
(h) Tests and calibrations of typical model channel, metal fins and control orifices completed. That portion of the model showing 60 miles of the Ohio River below Pittsburgh has been completed and tested experimentally.
(i) The model channels are designed to satisfy the general differential equation for flood-wave movement, velocity-head and acceleration-head effects being included in the representation.

....

(377) (a) MODEL STUDIES IN CONNECTION WITH THE RECONSTRUCTION OF THE EMSWORTH DAM ON THE OHIO RIVER 6 MILES BELOW PITTSBURGH.
(b) U. S. War Department.
(c) Laboratory investigation on a river model and on models of dam and gates.
(d) E.P. Schuleen and H. A. Thomas.
(e) Professor H. A. Thomas.
(f) Improvement of river navigation by raising the Pittsburgh pool to eliminate Monongahela Dam No. 1 and Allegheny Dam No. 1.
(g) Investigation includes the construction and testing of four models: (1) a 1:40 scale model of two bays of the dam to study the best hydraulic design for the piers, apron and gates; (2) a model of the entire main-channel structure to study the effects of currents on scour and navigation in the vicinity of the dam; (3) a 1:400 scale model of six miles of the river (including both the main and back-channel dams) to study the effect of the proposed structure on flood heights; and (4) a 1:12 scale model of a portion of one of the steel gates, to study pressure distributions on the faces of the gate when discharging water.
(h) Tests on the first model have been completed. Tests on the third model are still in progress. Work is being done to adjust the roughness of the model channel to accurate agreement with data obtained by field parties during recent high stages of the Ohio River. The fourth model is under construction.
(i) An unusual feature of the third model is the use of a micrometer hook gage for reading surface stages with extreme precision.

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(487) (a) MODEL STUDIES IN CONNECTION WITH THE CONSTRUCTION OF THE NEW GALLIPOLIS DAM ON THE OHIO RIVER.
(b) U. S. War Department.
(c) Laboratory investigation on a fixed-bed river model, and on models of dam and gates.
(d) E. P. Schuleen and H. A. Thomas.
(e) Professor H. A. Thomas.
(f) Improvement of navigation on the Ohio River.
(g) Investigation includes the construction and testing of three models: (1) a 1:250 scale model showing several miles of the Ohio River, including old dam No. 26, and the new Gallipolis Dam, to study methods of controlling cross currents in the river near the upstream entrance of the locks; (2) a 1:48 scale model of two bays of the dam, to obtain rating curves for the roller-type gates at various openings; and (3) a 1:16 scale model of a portion of one of the steel gates to study pressure distribution on the gate when discharging water.
(h) The first and second models have been constructed, and tests on them are nearing completion. Construction of the third model is now in progress.

....

(488)(a) MODEL STUDIES ON THE SPILLWAY OF THE WARRIOR RIVER DAM AT TUSCALOOSA, ALABAMA.
(b) U. S. War Department.
(c) Laboratory investigation using glass-sided flume.
(d) E. P. Schuleen and H. A. Thomas.
(e) Professor H. A. Thomas.
(f) Investigation included studies to determine the best elevation, width and shape of the spillway apron at different sections of this dam. Model was constructed to 1:20 scale in a glass-sided flume.
(h) Tests have been completed.

....

(489)(a) MODEL STUDIES TO INVESTIGATE CAVITATION EFFECTS AT ENTRANCES OF OUTLET CONDUITS OF TYGART RIVER DAM AND OTHER HIGH DAMS.
(b) U. S. War Department.
(c) Laboratory investigation.
(d) E. P. Schuleen and H. A. Thomas.
(e) Professor H. A. Thomas.
(f) Investigation includes the construction of apparatus suitable for making tests on model conduits under conditions such that the pressure of the atmosphere surrounding the model can be reduced in the model scale. Cavitation conditions in the model conduits are observed visually through a thick glass window, and are also studied by their erosion effects on the walls of the model conduits. Model walls are of lean mortar of strength adjusted to duplicate actual erosion effects in known cases of severe cavitation. Models of the conduits of the Tygart River Dam and of the Madden Dam are being constructed for testing in this apparatus. The apparatus includes a special 8 inch centrifugal pump, air-tight tank with 8-inch piping, and a Nash vacuum pump. Model scales of about 1:15 can be used.

The primary purpose of the tests is to develop entrance designs for high-head conduit which will largely or wholly eliminate cavitation.
(h) The apparatus has just been completed and the first model is being installed. This investigation has also included the construction of a 1:12 scale open model to study stream line paths and eddies in the conduit entrances of the Tygart River Dam and of the Madden Dam. This part of the work has been completed.
(i) The principle underlying the design of this apparatus is that if a model is to give a true representation of cavitation effects, it is necessary to reduce the surrounding atmospheric pressure in the model scale. Under this condition the first vacuum formation at some point in the flowing stream occurs at corresponding heads in the prototype and model.

....

(490)(a) INVESTIGATION OF TRAVELING WAVES IN STEEP CHANNELS.
(b) Pure research. This is an authorized project of the American Society of Civil Engineers' Special Committee on Hydraulic Research. During the present year the project is being carried on in cooperation with the thesis work of Mr. R. F. Schnake, graduate student.
(c) Laboratory investigation and theoretical analysis, together with field investigation of traveling waves in steep channels connected with actual engineering structures.
(d) H. A. Thomas and R. F. Schnake.
(e) Professor H. A. Thomas.
(f) To investigate the fundamental hydraulic principles governing the formation and propagation of traveling waves and surges in channels of steep slope, and to correlate analytical findings with experimental results. To obtain data which will enable the designer of a steep channel to predict the probable maximum height and velocity of the traveling waves which may form in the channel under the given conditions.
(g) An experimental timber channel adju table in length up to 40 feet and in slope up to about 70° has been constructed, together with apparatus for introducing traveling waves of various heights and amplitudes into the upper end of this channel. Velocities and profiles of these waves will be studied by photographic methods. Field studies on traveling waves in full-sized structures will involve the use of motion pictures.
(h) The experimental channel has been completed recently and preliminary tests are in progress. A rather extensive analytical investigation on the hydraulic theory of traveling waves in open channels has been carried on.

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UNITED STATES GOVERNMENT DEPARTMENTS.

BUREAU OF AGRICULTURAL ENGINEERING. Colorado Experiment Station, Fort Collins Laboratory.

(466)(a) STUDY OF SIZE OF INTAKE OPENINGS AND WELL-SCREEN DIAMETER IN RELATION TO THE YIELD OF WELLS.
(b) Colorado Experiment Station, Colorado State College.
(c) Laboratory study.
(d) W. E. Code.
(e) W. E. Code.
(f) To determine the relation of size of screen openings and well-screen diameter to the yield of wells, as far as a laboratory experiment of limited size will permit. Also, to determine the drawdown curve near the well in two sand and gravel mediums of different permeability.
(g) Study conducted in a tank containing a half cylinder of the medium 10 feet in diameter and 4 feet deep. Screen is of slotted galvanized steel well casing as commonly used in irrigation wells. Screen is half section with open side against glass window. Slots 1/16 inch and 3/16 inch wide used. Observation of drawdown curve made by means of brass tubes inserted from bottom and connected to glass manometer.
(h) Laboratory work about completed.

....

(467)(a) VORTEX-TUBE SAND TRAP INVESTIGATION.
(b) Bureau of Agricultural Engineering, U.S.D.A. and Colorado Experiment Station.
(c) Laboratory research problem to determine the shapes of tubes which operate most satisfactorily under different conditions of flow.
(d) R. L. Parshall, Senior Irrigation Engineer, Division of Irrigation, Bureau of Agricultural Engineering, in charge of project; Carl Rohwer, Associate Irrigation Engineer, conducting tests.
(e) none.
(f) The purpose of these tests is to determine the efficiency of various shapes of tubes in removing different sizes of sand under different conditions of flow.
(g) Known quantities of sand are dumped into the channel in which the tube being tested is located; the quantity caught and carried out by the tube in a definite time is measured and then compared with the original quantity.
(h) The portion of the study being made at the Bellvue Laboratory this season was completed November 30, 1935. Further tests will be made by R. L. Parshall this winter at the Imperial Valley Laboratory, El Centro, California. (See Project (246), Bulletin III-2, p. 28).
(i) The results of this study are to be published as a government bulletin.

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CORPS OF ENGINEERS, LINNTON HYDRAULIC LABORATORY.

(259) (a) BONNEVILLE POWER-NAVIGATION PROJECT ON THE COLUMBIA RIVER.
(b) United States Engineer Department, Portland District No. 2, Major C. F. Williams, District Engineer, Claude I. Grimm, Chief Engineer.
(c) A research program to check the hydraulic designs, to furnish data, and assist in visualizing the problems connected with the design, construction and future operation of the Bonneville Project.
(d) A. J. Gilardi, Resident Engineer in charge of the laboratory, J. C. Stevens, Consulting Engineer on model studies.
(e) United States District Engineer, Portland District No. 2, Portland, Oregon.
(f) 1. To determine the best design of cofferdams and the placement of cribs in the main channel for the construction of the main spillway dam. Depths of water in excess of 70 feet, with velocities in excess of 12 miles per hour, had to be expected even in a mild spring freshet. To determine the best method of sealing the cofferdam, specially in case of a blow-out.

2. To determine the best shape of the piers, spillway crest, toe and apron of the spillway dam so as to reduce the scour of the river bed and banks to a minimum.

3. To determine the pressure conditions, vacuum formation, and possible chattering at the bottom of the large 50 ft x 50 ft gates of the main spillway, for partial gate openings.

4. To determine the best method of operation of the gates of the spillway dam for handling flood waters, debris and floating ice, also for creating the most favorable conditions for getting fish over the dam, etc. The maximum flood on record is 1,170,000 cfs, and a still larger one was used as a basis for the design of the spillway.

5. To determine the backwater effect due to the construction of the project and its reduction to a minimum by means of channel improvements. This is an exceptionally important phase of the experimental program, on account of the presence of extensive and valuable improvements on both sides of the river, for instance, railroads, highways, farmlands, and numerous settlements.
6. To determine the best method of handling navigation during the various construction periods. This work was carried out mostly in the river model; an accurate model of a typical river boat was towed at numerous points and the hawser tensions were measured by means of specially designed and highly sensitive scales.
7. To determine the best design and method of operation for the navigation lock. The lock will be 76 ft wide, 550 ft long, will have a minimum depth over the sills of 25 ft and will be capable of handling sea-going vessels. The difference in pool levels will exceed 60 ft at low water; this will be handled in a single lift, which will represent the highest lift in the world.
8. To determine the best layout of fish ladders and other provisions for getting mature fish into the upper pool and small fish down into the tailwater and to the sea.
9. Numerous other experiments of lesser importance and others which may be required in the future as the work progresses.

(g) An outdoor laboratory covering an area of about 2 acres has been built at the Government Moorings near Linnton Station, Portland, Oregon. Water is pumped from the Willamette River and circulated through the various models. Five principal models have been built and operated up to date; the work is still in progress on most of them.

1. Lock model. The experimental work was carried out on a 1:36 scale model and lead to the adoption of a system of filling and emptying through culverts and ports located in the floor of the lock and controlled by means of valves located in the lock walls.

The study was made and completed in the early part of 1934, when a barge lock was under consideration; however, the results obtained at the time remained applicable in principle.

2. Spillway model and spillway flume. A spillway model on a scale of 1:36 was installed in a flume 5 feet wide, 5 feet deep, and about 75 ft long, provided with heavy plate glass walls at the upper end. This model corresponds to a total width of 180 ft and a length of about 1100 ft from the axis of the dam. It includes three of the 18 50 ft x 50 ft gates to be installed, with two piers and two half piers. Over 150 experiments have been made with a great variety of designs for the spillway dam, under a wide range of flows, and a final design for the structure has been developed and adopted.

The spillway flume has been used for many additional experiments in connection with the fishways, placement of cribs, sealing of cofferdams, etc.

3. River model. A 1:100 scale model of about 5 miles of the Columbia River has been built; it simulates the stretch from the head of Cascade Rapids to the mouth of Tanner Creek. The overall length of this model is about 325 ft; it was built by the template method, with sand tamped and washed in, and was finished with a three-inch layer of rich concrete between the templates.

The river model has been used for experiments in connection with the placement of cribs, cofferdam, closures, fishways, operation of the gates for handling flood waters, debris, and ice, handling of navigation, etc. The studies on backwater effect and its

reduction by means of channel improvements will be taken up in the near future.

4. Gate model. A 1:5 gate model of a 10 ft slice of the central portion of one of the 50 ft x 50 ft main spillway gates was built in a special flume, 2 ft wide and about 15 ft high. The gate bottom, as well as the crest of the dam, were provided with piezometers to observe the pressures and vacuum formation. The gate proper was hung on a scale by means of a spring support; so that the forces on the gate could be measured and eventual chattering could be detected.

The work on this model is still in progress; very valuable data have been obtained, and it was also determined that no chattering would take place even with very small gate openings.

5. Powerhouse diffusing chamber. A 1:8 scale model was built to study the best method of diffusing the water to be supplied into the fishway passage at the downstream end of the powerhouse. Baffles have been devised which permit an even diffusion of the water supply, so as not to divert the fish from their course.

(h) The Linnton Hydraulic Laboratory has been in operation for about 16 months; the work is still in progress.

All models described under (g) have been completed and placed in operation; the experimental work has been completed on some models, and they have been dismantled to make room for others. A brief description of the status of the work follows the description of the individual models (See par. g-1, g-2, g-3, g-4, and g-5).

The total cost of construction and operation of the laboratory has been small in comparison to the total engineering cost and insignificant when compared with the ultimate investment in the Bonneville project. The total investment in the laboratory has already paid for itself many times over in savings of valuable construction time and in numerous other ways.

(i) The work is being paid from the PWA appropriation for the Bonneville Dam. (PWA Project No. 28).

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CORPS OF ENGINEERS, EASTPORT DISTRICT.

(468) (a) THE DETERMINATION OF DISCHARGE COEFFICIENTS FOR VENTURI AND OPEN-TYPE SLUICE GATES FOR THE PASSAMAQUODDY TIDAL POWER PROJECT.

(b) Corps of Engineers, U.S.A.

(c) To furnish data for design of the sluice gate structure for restoring the operating pool level following generating cycles.

(d) Professor Charles M. Allen and staff.

(e) Captain Hugh J. Casey, C.E., U.S.A.

(f) To obtain rating curves for the discharge of both submerged Venturi and open-sluice type filling gates and to determine the most advantageous design of gate.

(g) Tests are conducted on 1/30 scale models, to determine the effectiveness of various features of design under the tidal conditions to be encountered during normal operation of the plant.

(h) Experimental work completed. Laboratory work nearly completed.

(i) Information concerning tests on this project may be obtained from the District Engineer, U.S.Engineer Office, Eastport, Maine.

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(469) (a) MODEL TESTS ON THE NAVIGATION LOCK FOR THE PASSAMAQUODDY TIDAL POWER PROJECT.
(b) Corps of Engineers, U.S.A.
(c) To furnish data for the design of the navigation lock to be constructed at the entrance to the high level operating pool.
(d) Professor Charles M. Allen and staff.
(e) Captain Hugh J. Casey, C.E., U.S.A.
(f) To check the computed filling and emptying time, and measure hawser stresses on the vessel, to insure that there will be no objectionable degree of turbulence during lockage.
(g) Tests are conducted on 1/30 scale models for various representative lifts and various rates of filling-valve operation.
(h) Experimental work recently started. It is estimated that the program will be completed in about three months.
(i) Information concerning tests on this project may be obtained from the District Engineer, U.S. Engineer Office, Eastport, Maine.

....

(470) (a) MODEL TESTS ON ROCKFILL DAMS FOR THE PASSAMAQUODDY TIDAL POWER PROJECT.
(b) Corps of Engineers, U.S.A.
(c) To furnish data for the design of rockfill dams for isolating Cobscook Bay as a high-level operating pool.
(d) Professor Charles M. Allen and staff.
(e) Captain Hugh J. Casey, C. E., U.S.A.
(f) The full-scale prototype is to be constructed by dumping material directly into the tidal flow without employing auxiliary cofferdams. The purpose of the model experiments is to determine the profile of cross-section and the size of stones required at various elevations to resist displacement by the overflow.
(g) Tests are conducted on 1/50 scale models for various representative stages of construction and using selected critical instantaneous values of pool and ocean tide, as determined by a comprehensive series of computations prepared in advance.
(h) Experimental work recently started. It is estimated that the work will be completed in about three months.
(i) Information concerning tests on this project may be obtained from the District Engineer, U. S. Engineer Office, Eastport, Maine.

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CORPS OF ENGINEERS, ZANESVILLE DISTRICT.

See projects reported under "Case School of Applied Science."

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U. S. WATERWAYS EXPERIMENT STATION.

(51) (a) SUSPENDED LOAD INVESTIGATIONS.
(b) Mississippi River and Tributaries.
(c) All experiments are prosecuted to the end of aiding in the development of plans for flood control, harbor improvement, navigation, etc. All have a direct practical application to the work of the Corps of Engineers, U.S.Army, in its administration of the Rivers and Harbors of the Nation. The U. S. Waterways Experiment Station holds as an unvarying principle the maintenance of the closest contact with the field in all experimental work. This contact is kept both by Station personnel visiting the prototype and by engineers from the field visiting the Station while any particular model study is in progress.
(d) All experiments are conducted at the U. S. Waterways Experiment Station by personnel of the Station under the direction of Lieut. Francis H. Falkner, Director of the Station.
(e) The Director, U. S. Waterways Experiment Station.
(f) Study of suspended load carried by the Mississippi River, its tributaries, and the Atchafalaya River - Silting of reservoirs - study of the behavior of different sediment traps. Design of new traps.
(g) Field and laboratory investigations, analyses of samples, compilation of curves, comparison of results obtained from different traps.
(h) Studies for 1930-31 reported on, other studies inactive at present.
(i) See list of publications, U. S. Waterways Experiment Station.

....

(52) (a) SOIL INVESTIGATIONS.
(b) Navigable Waterways, U.S.A.
(c) (d) and (e) See (51).
(f) Study physical properties of soils, especially as they pertain to levee construction.
(g) Mechanical analyses, Atterburg Limits, permeability tests, microscopic examinations, specific gravity determinations, shear and compression tests of samples undisturbed and otherwise, obtained under the supervision of the Station. Study of subsidences by use of pre-set plates established throughout the compressible strata at critical points for measuring the progress of consolidation in the strata. Checking observed results against anticipated settlement determined from study of undisturbed samples of foundation material.
(h) Studies in progress continually.

....

(59) (a) LEVEE SEEPAGE.
(b) Mississippi River Commission.
(c) (d) and (e) See (51).
(f) Study and observe hydraulic gradient and flow lines in levees and models of levees of standard sections of various materials placed by various methods.

(g) Loop of levees, standard section, 10 feet high, of various materials and placed in various ways, kept full; measurements taken.
(h) First phases of experimental work complete. Study inactive at present.

....

(74) (a) TRACTIVE FORCE.
(b) Mississippi River Commission.
(c) (d) and (e) See (51).
(f) To determine relation between physical properties of bedload materials and tractive force required to move them. Also to determine laws governing rate of bed-load movement.
(g) Tests in special tilting flume checked by special runs in models.
(h) Initial phases of experimental work complete. Tests are being continued, using artificial mixtures, in glass-sided flume. Range of sizes to be extended to include small gravels. Materials of low specific gravity being investigated.
(i) Results of initial tests are contained in Paper 17. Results of tests of coarse materials are contained in Technical Memorandum 69-1.

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(77) (a) ISLAND NO. 35, MISSISSIPPI RIVER.
(b) Mississippi River Commission.
(c) (d) and (e) See (51).
(f) Develop methods of improving navigation conditions.
(g) Movable bed model of river from Mile 181.4 to 204.0 below Cairo. Model scales are 1:600 horizontal and 1:150 vertical.
(h) Original experiment and additional studies completed. Model temporarily inactive.
(i) Reports of original experiment included in Technical Memoranda Nos. 29, 29-2, 3, 4, 5, 6, 7, 8, U. S. Waterways Experiment Station. Report on most recent study is to be found in Technical Memorandum No. 29-8.

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(91) (a) MISSISSIPPI RIVER MODEL NO. 4 - INCLUDING THE MISSISSIPPI RIVER FROM MILE 560 TO MILE 655 BELOW CAIRO.
(b) Mississippi River Commission.
(c) (d) and (e) See (51).
(f) Miscellaneous problems involving flood control and channel stabilization between the limits specified in (a). Reaches studied: Millikens Bend, King's Point, Racetrack Towhead, Diamond Point Cut-off, Buckridge Crossing, and Yucatan Point Cut-off. Most recent study made on Delta Point Reach.
(g) Model scales: 1 to 1000 horizontal and 1 to 100 vertical; movable bed. For most recent tests the movable bed was fixed.
(h) Model intermittently active.
(i) Results of these studies are described in Technical Memoranda Nos. 34, 34-2, 38-1, 47-1, 47-2, 47-3, 47-4, 47-5, 58-1, 58-2, 58-3, 72-1, U. S. Waterways Experiment Station. Technical Memorandum No. 88-1 contains results of most recent study.

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(92) (a) MISSISSIPPI RIVER MODEL NO. 5 - INCLUDING THE MISSISSIPPI RIVER FROM MILE 650 TO MILE 762.5 BELOW CAIRO.
(b) Mississippi River Commission.
(c) (d) and (e) See (51).
(f) Miscellaneous problems involving flood control and channel stabilization within the limits specified in (a). Reaches studied: Bondurant Towhead, Waterproof Cut-off, Rifle Point, Cowpen Point Cut-off, Natchez Island, Esperance Point - Morville Landing, Glasscock Point Cut-off.
(g) Model scales: 1 to 1000 horizontal and 1 to 100 vertical; movable bed.
(h) Model intermittently active.
(i) Results of these studies are described in Technical Memoranda Nos. 32-1, 32-2, 32-3, 32-4, 42-1, 42-2, 42-3, 42-4, 42-5, 60-1, 82-1, 82-2, Waterways Experiment Station.

....

(153) (a) ARTICULATED CONCRETE MATTRESS STUDY.
(b) U. S. District Engineer, Memphis, Tennessee.
(c) (d) and (e) See (51).
(f) Relative protection afforded banks by two types of articulated concrete mattress.
(g) Installation of full size mattress units on the banks of the creek from which Station water supply is derived. Observations of erosion from floods will be made.
(h) In progress.

....

(163) (a) MISSISSIPPI RIVER MODEL NO. 1, INCLUDING THE MISSISSIPPI RIVER FROM MILE 390 TO MILE 810 BELOW CAIRO, THE RED RIVER FROM ITS MOUTH TO MILE 33 ABOVE BARBRE LANDING, AND THE ATCHAFALAYA RIVER FROM ITS HEAD TO MILE 35 BELOW BARBRE LANDING.
(b) Mississippi River Commission.
(c) (d) and (e) See (51).
(f) Miscellaneous problems affecting water surface elevations within the limits specified in (a). Problems studied: Ten proposed cut-offs, Leland and Tarpley Neck Cut-offs, Brunswick Levee Extensions, Natchez Levee Set-back, and Enlargement of the Atchafalaya River.
(g) Model scales 1 to 2400 horizontal and 1 to 120 vertical; fixed bed.
(h) Present series of tests completed. Model temporarily inactive.
(i) Results of several studies are described in Technical Memoranda Nos. 25, 25-A, 25-B, 25-C, 25-D, 34, 34-2, 50-1, 50-2, U. S. Waterways Experiment Station.

....

(165) (a) MISSISSIPPI RIVER BED MATERIAL SURVEY.
(b) Mississippi River Commission.
(c) (d) and (e) See (51).
(f) To determine characteristics of material composing the bed of the Mississippi River and its principal tributaries.

(g) Samples taken from bed of Mississippi River at about one-mile intervals from Cairo to Gulf of Mexico, and from beds of Ohio, Old, Red, Black and Atchafalaya Rivers and the Atchafalaya Basin. Supplementary samples later taken from Arkansas, White, Ouachita, Yazoo, St. Francis, Ohio, Tennessee, Cumberland, Wabash, Missouri, and Illinois Rivers. Special trap used for procuring samples. Mechanical and hydrometer analysis, specific gravity tests, and microscopic examination were made of each sample. Petrographic study is being made.

(h) Analyses of samples from Mississippi, Ohio, Atchafalaya, Red, Black, and Old Rivers completed and tabulated. Analyses of other tributary samples completed. Petrographic study in progress.

(i) Paper 17 includes results of analyses of Mississippi, Ohio, Atchafalaya, Red, and Old River samples.

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(166) (a) U. S. INTRACOASTAL WATERWAYS CROSSING WITH BRAZOS RIVER DIVERSION CHANNEL, NEAR FREEPORT, TEXAS.

(b) U.S.District Engineer, Galveston, Texas.

(c) (d) and (e) See (51).

(f) Study to eliminate shoaling in canal caused by waters of Brazos River.

(g) Scale 1 to 200 horizontal and 1 to 45 vertical. A silt-laden discharge of water and bed material added to the stream used in simulating flow in Brazos River Diversion Channel. Various improvement plans are being tested.

(h) Additional tests are in progress.

(i) Results of experiment are in Technical Memorandum No. 54-1, U. S. Waterways Experiment Station.

....

(168) (a) HEAD OF PASSES, MISSISSIPPI RIVER.

(b) U. S. District Engineer, 1st N.O. District, New Orleans, La.

(c) (d) and (e) See (51).

(f) Determine methods of improving navigation conditions at Head of Passes.

(g) Movable bed model extending from 8 miles above to 6 miles below Head of Passes. Model scales 1 to 600 horizontal and 1 to 150 vertical.

(h) Original studies completed. Additional studies requested by The Division Engineer, Gulf of Mexico Division, are now in progress.

(i) Reports on original studies included in Technical Memoranda Nos. 46-1, -2, -3, -4, -5, -6, -7, U. S. Waterways Experiment Station.

....

(170) (a) MISSISSIPPI RIVER MODEL NO. 2, INCLUDING THE MISSISSIPPI RIVER FROM MILE 370 TO MILE 445 BELOW CAIRO, 60 MILES OF THE ARKANSAS RIVER, AND 60 MILES OF THE WHITE RIVER.

(b) Mississippi River Commission.

(c) (d) and (e) See (51).

(f) Determine effects of separating mouths of Arkansas and White Rivers; also effects of cut-offs on these rivers upstream from mouth and miscellaneous problems for channel stabilization and navigation.

(g) Model scales 1 to 1000 and 1 to 100; fixed bed.
(h) Model temporarily inactive.
(i) Results of this study are described in Technical Memorandum No. 51-1.

....

(198) (a) FITLER BEND, MISSISSIPPI RIVER.
(b) Mississippi River Commission.
(c) (d) and (e) See (51).
(f) Study for improvement of navigation and miscellaneous hydraulic problems.
(g) Model scales 1 to 500 and 1 to 150; movable bed.
(h) Temporarily inactive.
(i) Results to date of this study are described in Technical Memorandum No. 56-1.

....

(199) (a) ARANSAS PASS, GULF OF MEXICO.
(b) The Division Engineer, Gulf of Mexico Division.
(c) (d) and (e) See (51).
(f) To determine best improvement for navigation channel through pass.
(g) Tidal study. Scale of model, 1 to 500 horizontal and 1 to 100 vertical. A reversible flow of water simulating tidal action, and a movable bed, is used to test proposed improvement works.
(h) Completed.
(i) Results described in Technical Memorandum No. 67-1.

....

(253) (a) CAT ISLAND, MISSISSIPPI RIVER.
(b) U. S. District Engineer, Memphis, Tennessee.
(c) (d) and (e) See (51).
(f) Study of proposed regulating works.
(g) Movable bed model from Mile 241.2 to Mile 275.0 below Cairo. Model scales 1 to 1000 horizontal and 1 to 125 vertical.
(h) Temporarily inactive.
(i) Report included in Technical Memorandum No. 63-1, U.S. Waterways Experiment Station.

....

(255) (a) CONEY ISLAND DIKE MODEL.
(b) District Engineer, Cincinnati, Ohio.
(c) (d) and (e) See (51).
(f) Determine method of improving the navigability of the Ohio River in the vicinity of Dam No. 36.
(g) Model scales: 1 to 250 horizontal and 1 to 60 vertical; fixed bed.
(h) Completed.
(i) Results of experiments are included in Technical Memoranda Nos. 64-1, 64-2, 64-3, U.S. Waterways Experiment Station.

....

(256) (a) MISSISSIPPI RIVER MODEL NO. 3 - INCLUDING THE MISSISSIPPI RIVER FROM MILE 486 TO MILE 531 BELOW CAIRO.
(b) Mississippi River Commission.
(c) (d) and (e) See (51).
(f) Miscellaneous problems involving the river within the limits specified in (a). Reaches Studied: Walker Bend - American Cut-off, Worthington Point Cut-off, Kentucky Bend, and Cracraft Chute.
(g) Model scales 1 to 1000 horizontal and 1 to 100 vertical; movable bed.
(h) Model intermittently inactive.
(i) Results of studies are described in Technical Memoranda Nos.59-1 and 74-1, U. S. Waterways Experiment Station.

....

(257) (a) DIRECTIVE ENERGY STUDY.
(b) Mississippi River Commission.
(c) (d) and (e) See (51).
(f) Experiments to determine relations between length of tangent, length of pool, total length, slope, and bed material of rivers.
(g) Outdoor flume, 50 ft x 15 ft with movable bed, being used.
(h) In progress.
(i) Results of experiments, todate, are included in Technical Memoranda Nos. 61-1, -2, -3, and -4, U.S.Waterways Experiment Station.

....

(409) (a) STUDIES OF PIPE LINE MIXERS.
(b) The District Engineer, U.S.Engineer Office, Memphis, Tenn.
(c) (d) and (e) See (51).
(f) To study the effect of rifles in dredge discharge pipes on the percentage of solids that can be pumped without increasing the power of the dredge. Size, pitch, and spacing of rifles will be studied, and the efficiency of various designs compared with the efficiency of the smooth discharge pipe.
(g) Tests being made in 4-inch observation pipe.
(h) In progress.

....

(410) (a) BROWN LAKE SPILLWAY MODEL.
(b) Mississippi River Commission.
(c) (d) and (e) See (51).
(f) To determine the head-discharge relation for the spillway crest, and to determine means of eliminating scour below the apron of the spillway.
(g) Model scale 1 to 20, undistorted.
(h) Head-discharge study completed. Study of scour elimination in progress.

....

(414) (a) MODEL STUDY TO DETERMINE EFFICACY OF SUB-LEVEES AND THEIR EFFECT IN CONTROLLING THROUGH AND UNDER-SEEPAGE FOR MAIN LINE LEVEES.
(b) The District Engineer, U. S. Engineer Office, Memphis, Tenn.
(c) (d) and (e) See (51).
(f) To determine, by means of flow nets developed from models, the relative quantities of seepage, etc.
(g) Permeability tests, mechanical analyses.
(h) Tests in progress.

....

(415) (a) MISSISSIPPI RIVER MODEL - HELENA, ARKANSAS TO DONALDSONVILLE, LOUISIANA, INCLUDING THE MISSISSIPPI RIVER FROM MILE 298 TO MILE 900 BELOW CAIRO, AND ESSENTIAL PORTIONS OF ALLUVIAL VALLEY FROM HELENA, ARKANSAS TO THE GULF OF MEXICO.
(b) Mississippi River Commission.
(c) (d) and (e) See (51).
(f) Miscellaneous problems regarding water surface elevations within limits specified.
(g) Model scales, 1 to 2000 horizontal and 1 to 100 vertical; fixed bed.
(h) In progress.

....

(416) (a) PORT WASHINGTON, WISCONSIN, LAKE MICHIGAN.
(b) U. S. District Engineer, Milwaukee, Wisconsin.
(c) (d) and (e) See (51).
(f) Study to determine best breakwater system for harbor.
(g) Scale of model 1 to 50, undistorted, fixed bed. A plunger apparatus used to reproduce waves. Various proposed breakwater plans tested.
(h) Completed.
(i) Results of tests are to be found in Technical Memorandum No. 87-1, U.S.Waterways Experiment Station.

....

(417) (a) MARE ISLAND STRAIT, SAN FRANCISCO BAY, CALIFORNIA.
(b) U.S.District Engineer, San Francisco, California.
(c) (d) and (e) See (51).
(f) Study to determine means of eliminating shoaling in navigation channel.
(g) Design suspended awaiting field data.

....

(471) (a) CHESAPEAKE AND DELAWARE CANAL MODEL.
(b) The District Engineer, U. S. Engineer Office, Philadelphia, Pennsylvania.
(c) (d) and (e) See (51).
(f) To study methods of eliminating shoaling in the Delaware River entrance to the Chesapeake and Delaware Canal.
(g) Model scales of 1 to 800, horizontal, and 1 to 80 vertical. Movable bed. Tidal flow is to be simulated. Various proposed plans for eliminating shoaling will be tested.
(h) Model in construction stage.

....

(472) (a) BALLONA CREEK OUTLET MODEL.
(b) The District Engineer, U.S.Engineer Office, Los Angeles, California.
(c) (d) and (e) See (51).
(f) Maintenance of flood channel at outlet into ocean.
(g) Model scales, 1 to 100 horizontal, and 1 to 50 vertical. Movable bed. Tidal flow and wave action to be reproduced.
(h) Model in construction stage.

....

(473) (a) MARACAIBO OUTER BAR MODEL.
(b) Standard Shipping Company, New York, N. Y.
(c) Investigation of progressive westward movement of the outer bar with view to ascertain any probable future development.
(d) and (e) See (51).
(f) To study outer bar action at entrance of Lake of Maracaibo, Venezuela.
(g) Scale of model 1 to 300, horizontal, 1 to 50 vertical. Tidal flow and wave action to be reproduced. Movable bed.
(h) Model in construction stage.

....

(474) (a) DEBRIS PRESSURE TESTS.
(b) The Division Engineer, South Pacific Division, 414 Customhouse, San Francisco, California.
(c) (d) and (e) See (51).
(f) To determine whether or not a greater than water pressure is exerted against dams for the retention of mining debris and if so, to determine the pressure.
(g) Pressure tests using local soils and an apparatus consisting of a chamber, one side of which is formed by a movable steel gate, and scales by means of which the horizontal and vertical reactions against the gate are measured.
(h) Completed.
(i) Report rendered to the Division Engineer, South Pacific Division, 414 Customhouse, San Francisco, California.

....

(475) (a) INVESTIGATION OF SOIL SAMPLES FROM THE BANKS OF THE BRAZOS RIVER NEAR FREEPORT, TEXAS.
(b) The District Engineer, U. S. Engineer Office, Galveston, Texas.
(c) (d) and (e) See (51).
(f) To determine the stable slopes of river bank for revetment purposes, knowing the physical properties and characteristics of the material in the slopes.
(g) Mechanical analyses, Atterburg Limits, shear tests by direct method, specific gravities, and water contents.
(h) Completed.
(i) Report rendered to the District Engineer, U. S. Engineer Office, Galveston, Texas.

....

(476) (a) TESTS AND INVESTIGATION OF SOIL FROM SITE OF U. S. MARINE HOSPITAL, MEMPHIS, TENNESSEE.
(b) Treasury Department, U.S.Public Health Service, Marine Hospital, Memphis, Tennessee.
(c) (d) and (e) See (51).
(f) The determination of the maximum safe stable slope for a graded hillside carrying no surcharge.
(g) Tests for classification of the material, mechanical analysis and Atterburg Limits; detailed tests, shear by the direct method, consolidations, permeability, absolute specific gravity and water content for determining its strength and condition in situ.
(h) Completed.
(i) Report rendered to the Associate Structural Engineer, U. S. Public Health Service, Marine Hospital, Memphis, Tennessee.

....

(477) (a) PHYSICAL AND CHEMICAL TESTS OF SOIL FROM SITE OF CONCHAS DAM, NEAR TUCUMCARI, NEW MEXICO.
(b) The District Engineer, U. S. Engineer Office, Tucumcari, New Mexico.
(c) (d) and (e) See (51).
(f) The determination of the suitability and action of the material represented by the samples, for earth dam construction and the foundation of a contemplated earthen or rock fill dam.
(g) Classification tests, mechanical analyses and Atterburg Limits. Chemical analyses and determination of per cent of water soluble constituents on a weight basis of entire specimen. Detailed tests for design purposes, shear, consolidation, permeability, absolute specific gravity and water content for undisturbed and remolded samples.
(h) Testing continued as exploration of subsoil and borrow pits progresses.
(i) Reports rendered as testing progresses.

....

(478) (a) BUCKRIDGE CROSSING MODEL, MISSISSIPPI RIVER, MILE 631 TO MILE 636 BELOW CAIRO.
(b) Mississippi River Commission.
(c) (d) and (e) See (51).
(f) To determine methods of improving navigation conditions over Buckridge Crossing.
(g) Model scale 1 to 450 horizontal and 1 to 150 vertical. Fixed bed.
(h) Completed.
(i) Results described in Technical Memorandum 79-1, U.S. Waterways Experiment Station.

....

(479) (a) MEMPHIS DEPOT STUDY, MISSISSIPPI RIVER, MILE 226 TO MILE 234 BELOW CAIRO.
(b) The District Engineer, U.S.Engineer Office, West Memphis, Arkansas.
(c) (d) and (e) See (51).

(f) Determine method of improvement of navigation channel to the Memphis Engineer Supply and Repair Depot.
(g) Model scales, 1 to 450 horizontal and 1 to 150 vertical. Movable bed.
(h) In progress.

....

(480) (a) GALVESTON HARBOR MODEL.
(b) The District Engineer, U. S. Engineer District, Galveston, Texas.
(c) (d) and (e) See (51).
(i) Feasibility of model study being investigated.

....

(481) (a) ABSECON INLET MODEL.
(b) The District Engineer, U. S. Engineer Office, Philadelphia, Pa.
(c) (d) and (e) See (51).
(i) Feasibility of model study being investigated.

....

GEOLOGICAL SURVEY, WATER RESOURCES BRANCH.

(26) (a) PERMEABILITY TESTS CONDUCTED UNDER VERY LOW HYDRAULIC GRADIENTS.
(b) United States Geological Survey, Water Resources Branch.
(c) General scientific research.
(d) O. E. Meinzer, V. C. Fishel.
(e) O. E. Meinzer, U. S. Geological Survey, Washington, D. C.
(f) The purpose of this experiment is to find out if there is a flow of liquids through porous material with hydraulic gradients as low as one foot per mile or less, and if there is a flow at such low gradients, to ascertain if it follows Darcy's law which states that the flow of water through a given porous material varies directly as the hydraulic gradient.
(g) The present investigation is conducted with a U-shaped non-discharging type of apparatus having a column of material two meters in length. An initial hydraulic gradient is established by adjusting the water levels so that the level in one column is slightly higher than in the other. Observations are then made on the rate of change of the water levels.
(h) This project has been completed. The results of the investigation are included in the Transactions of the American Geophysical Union, 1935, pp 499-503.

....

(27) (a) THIEM'S METHOD FOR DETERMINING PERMEABILITY OF WATER-BEARING MATERIALS.
(b) The U. S. Geological Survey in cooperation with the Conservation and Survey Department of the University of Nebraska.
(c) General scientific research.
(d) L. K. Wenzel.
(e) L. K. Wenzel, U. S. Geological Survey, Washington, D. C.

(f) Pumping tests were conducted near Grand Island, Nebraska, during the summer of 1931 as a part of a cooperative investigation of the ground-water resources of the Platte Valley to determine the practicability of Thiem's method for determining permeability of water-bearing materials. Two additional pumping tests were made during 1933, one at Gothenburg and the other at Kearney, using a modified method of procedure that was determined by the test near Grand Island to give the most accurate results. See Bulletin II-1 for further details.

(i) The results of the pumping tests near Grand Island will be published by the United States Geological Survey as Contribution to the Hydrology of the United States and the results of the other two tests will be published ultimately in a report on the ground-water resources of the Platte Valley.

....

(265)(a) STUDY OF THE SIZE OF INTAKE OPENINGS OF WELL SCREENS IN RELATION TO THE YIELD OF WELLS AND THE PERMEABILITY OF WATER-BEARING FORMATIONS.

(b) United States Geological Survey, Water Resources Branch.

(c) General scientific research.

(d) A. G. Fiedler, M. A. Pentz.

(e) A. G. Fiedler, U. S. Geological Survey, Washington, D. C.

(f) The purpose of this study is to determine the effect of the size of intake openings of well screens upon the yield of wells and also to determine the relationship between the yield of a well of a definite type to the permeability of the water-bearing formation.

(g) The permeability of the water-bearing formation will be determined by field pumping tests in accordance with the method suggested by Thiem as modified by L. K. Wenzel as the result of tests made in the Platte Valley, Nebraska. Laboratory tests of permeability will also be made. Wells finished with screens having different sizes of intake openings, but otherwise of identical construction will be drilled in a selected area. The wells will be pumped at different rates and observations of the drawdown of the pumped well, and the lowering of the water-table in other observation wells will be made, and the relationship between yield, size of screen slot and permeability will be determined.

(h) Field work has been completed.

....

(482) (a) THE CHANNEL-STORAGE METHOD OF MEASURING GROUND-WATER DISCHARGE.

(b) United States Geological Survey, Water Resources Branch.

(c) General scientific research.

(d) O. E. Meinzer, R. C. Cady, V. C. Fishel.

(e) O. E. Meinzer, U. S. Geological Survey, Washington, D. C.

(f) The purpose of this project is to test the channel-storage method of determining ground-water run-off or effluent seepage.

(g) This investigation is being made on the upper part of the drainage basin of the Difficult Run, comprizing an area of about 1 square mile, near Fairfax, Virginia. The theory of the investigation is essentially as follows: During periods in which there is no direct run-off from the surface, the ground-water run-off or effluent seepage from the basin above any point on the stream is equal to the total discharge of the stream past that point

minus the increase in channel storage. In the present investigation, the channel storage of the stream at different stages is determined by means of cross-section profiles and gage-height readings at 100-foot intervals. The data thus obtained are correlated with the rate of discharge at the master gaging station as determined by the usual stream-gaging methods. Subsequently, the channel storage at any time is ascertained from the record of the automatic water-stage recorder at the master gaging stations by means of a channel-storage rating table. The installations consist of a weir and water-stage recorder at the master gaging station, 134 subsidiary gaging stations for determining channel storage, a recording rain gage, and 8 observation wells, of which 3 are equipped with automatic water-level recorders. Automatic water-level recorders are also installed on the stream in the vicinity of the observation wells and at a gaging station near the mouth of Difficult Run.

(h) The above-mentioned installations have been made. Rating tables for the stream discharge and the channel storage at low stages have been completed. Continuous rain and stream discharge records are being collected.

....

BUREAU OF RECLAMATION.

(248) (a) GRAND COULEE DAM, COLUMBIA RIVER.
(b) U. S. Bureau of Reclamation.
(c) Routine laboratory study.
(d) Hydraulic Research Department of U. S. Bureau of Reclamation.
(e) U. S. Bureau of Reclamation, Denver, Colorado.
(f) Improve and check the design of the proposed structure.
(g) Tests of 1:184 sectional model of spillway completed.
Tests of 1:120 model of completed structure in progress.
Tests of 1:40 sectional model of spillway completed.
Tests of 1:15 sectional model of spillway completed.
Tests of 1:30 sectional model of drum gate crest completed.
Studies of turbine draft tubes in progress.
Construction of 1:120 model of initial development to study diversion procedure in progress.
Studies of sluiceway control gates and sluiceway inlets in progress.
(h) Tests under way and preliminary report in preparation.

....

(339) (a) MOON LAKE DAM SPILLWAY TESTS.
(b) U. S. Bureau of Reclamation.
(c) Routine laboratory tests.
(d) Hydraulic Research Department of U. S. Bureau of Reclamation.
(e) U. S. Bureau of Reclamation, Denver, Colorado.
(f) Improve and check design of proposed structure.
(g) 1:60 model of spillway chute and stilling pool.
(h) Studies of revised design in progress.

....

(381) (a) IMPERIAL DAM AND ALL-AMERICAN CANAL INTAKE MODEL TESTS.
(b) U. S. Bureau of Reclamation.
(c) Routine laboratory studies.
(d) Hydraulic Research Department of U. S. Bureau of Reclamation.
(e) U. S. Bureau of Reclamation, Denver, Colorado.
(f) Improve and check the design of the proposed structure.
(g) A 1:40 model of the entire Imperial Dam, including the intake works to the All-American Canal and all appurtenant works, and several thousand feet of the Colorado River is being tested at the outdoor laboratory at Montrose, Colorado.
(h) Testing discontinued for winter season.

....

TENNESSEE VALLEY AUTHORITY.

(494) (a) PICKWICK LANDING DAM, SPILLWAY DESIGN.
(b) Tennessee Valley Authority.
(c) Investigation of stilling basin and shape of spillway crest for Pickwick Landing Dam.
(d) Laboratory staff under direction of G. H. Hickox.
(e) A. S. Fry, Head Engineer, Tennessee Valley Authority, Knoxville, Tenn.
(f) To determine a satisfactory and economical design of apron below the dam in order to dissipate energy and to determine the best shape of spillway crest.
(g) Tests made on models built to at least two different scales. Action of stilling basin observed through glass observation panel in side of flume.
(h) Tests on a 1:50 scale model have resulted in a tentative design of stilling basin. Action of stilling basin will be checked and detailed investigations of conditions at the crest will be made on a 1:25 scale model now under construction.

....

(495) (a) PICKWICK LANDING DAM, COFFERDAMS.
(b) Tennessee Valley Authority.
(c) Investigation of effect of cofferdamming and construction operations on river regimen.
(d) Laboratory staff under direction of G. H. Hickox.
(e) A. S. Fry, Head Engineer, Tennessee Valley Authority, Knoxville, Tenn.
(f) To determine the effect of proposed cofferdams and dredging operations during construction on river stages, navigation, and scour; to determine the allowable constriction of the river channel by cofferdams in each of the various stages of construction.
(g) A model of 9,000 feet of the Tennessee River including the dam site has been built to a scale of 1:100. At the site, 3800 ft of the channel has been formed in fine sand in order to investigate scouring conditions. Scale models of all proposed construction features such as cofferdams, lock, powerhouse and spillways are put in place to simulate various proposed phases of construction, and the effects on the river observed in order to determine the best sequence of operations.

(h) The model has been built and verified. Tests on the conditions during the construction of the lock have been completed, and tests are now under way to determine the conditions during the second year of construction for various proposed cofferdams.

....

NATIONAL BUREAU OF STANDARDS. (National Hydraulic Laboratory.)

(42) (a) INVESTIGATION OF THE PHYSICS OF PLUMBING.
(c) General research.
(d) R. B. Hunter, G. E. Golden.
(e) The Director, National Bureau of Standards.
(f) To obtain data on which to base logical estimates of the capacities of drain pipes, vertical and sloping, in plumbing systems and to make a study of safety requirements with special reference to back-siphonage and to venting.
(g) It is proposed to collect and to correlate as far as possible existing data on these subjects and to make such supplementary experiments as may be necessary to meet the purposes of the investigation.
(h) Apparatus for testing in connection with the study of back-siphonage has been installed, and it is expected that experiments will be started at an early date.

....

(43) (a) INVESTIGATION OF PIPE BENDS.
(b) U. S. Bureau of Reclamation.
(c) General research.
(d) K. H. Beij, G. H. Keulegan, G. E. Golden.
(e) The Director, National Bureau of Standards.
(f) To obtain the general laws of head loss in pipe bends; to correlate, insofar as possible, all available results of previous investigations; to obtain practicable formulas for use of engineers; and to extend the results to include flow of other fluids, such as oils, steam, etc.
(g) Laboratory tests will be made on smooth and rough pipe bends; on sizes up to 20 inch diameter if funds permit; on bends of various central angles and on miter bends and cast fittings.
(h) Tests have been completed on 3/8-inch brass tubing with bends having central angles varying from 5 to 180 degrees. It is expected that the results will be published about April 1, 1936. Tests have been completed on 4-inch steel pipe with 90 degree bends of radii varying from 6 inches to 7 feet. It is expected that the results will be published about June 1, 1936. Preparations are being made for tests on coils of 1-inch copper pipe and also on bends of either 6 or 10 inch copper pipe.

....

(129)(a) TRANSPORTATION OF SEDIMENT, COLORADO RIVER.
(b) U. S. Bureau of Reclamation.
(c) General research.
(d) C. A. Wright, B. H. Monish.
(e) The Director, National Bureau of Standards.
(f) To determine the relative scouring action on a bed of fine sand of clear water and of water containing a considerable amount of fine silt and clay.

(g) Experiments have been conducted with the apparatus described in Bulletin II-2 by the methods described in Bulletin III-1.
(h) Project completed.
(i) Report available for loan. See abstract in this bulletin.

....

(171)(a) INVESTIGATION OF THE PRESSURE VARIATIONS ON THE UPSTREAM AND DOWNSTREAM SIDES OF AN ORIFICE PLATE.
(b) Scientific data, National Bureau of Standards.
(c) National Bureau of Standards research.
(d) H. S. Bean, F. C. Morey.
(e) The Director, National Bureau of Standards.
(f) To obtain more complete data than is now at hand on the variations of pressure in the vicinity of an orifice plate, which will assist in better correlation of orifice coefficient data.
(g) Water from a constant head tank will be discharged through the orifice section of the line into either a weighing or calibrated tank. Simultaneous readings will be made of the pressure at 48 pressure openings extending from the orifice plate face to about 4 pipe diameters upstream and 10 pipe diameters downstream. It is planned to vary the ratio of orifice to pipe diameter from about 0.05 to over 0.8, and to vary the Reynolds number over at least 1 to 10 range for each orifice.
(h) Tests have been started, but improvements to the set-up are being made as the need arises and time permits.
(i) It is possible the same set-up will be used later for similar tests using air in place of water.

....

(195)(a) LAWS OF SEDIMENT TRANSPORTATION.
(b) Proposed by U.S.Corps of Engineers and U.S.Bureau of Reclamation.
(c) General research.
(d) C. A. Wright, B. H. Monish.
(e) The Director, National Bureau of Standards.
(f) Study of the laws of transportation of bed load by flowing water.
(g) The following studies are planned: validity of Du Boys' law of tractive force as a criterion for the movement of bed load, taking into account the vertical velocity distribution curve; relation of bed load movement to mean and bottom velocity of the water; critical tractive force for various mixtures and different degrees of sharpness; effect on critical tractive force of fine silt or clay particles mixed with the sand; comparison of critical tractive force as determined by different criteria; coefficient of roughness for flow with sand bed, with no movement of sand and with various degrees of sand movement and riffling.
(h) A portion of the work on Project 129 applies on this project.
(i) See Abstract for Project 129 in this bulletin.

....

(196) (a) MODES OF TRANSPORTATION OF SAND BY FLOWING WATER.
(b) Proposed by the U. S. Geological Survey.
(c) General research.
(d) C. A. Wright, B. H. Monish.
(e) The Director, National Bureau of Standards.
(f) Study of the various modes of transportation of bed and suspended load by flowing water.
(g) Study of the formation, dimensions and motion of riffles and traveling banks under different conditions; quantity of bed load as related to depth, slope, velocity, etc.; mechanism of suspension and laws of suspended load.
(h) A portion of the work on Project 129 applies on this project.
(i) See abstract for Project 129 in this bulletin.

....

(258) (a) STUDY OF DIVISORS FOR SOIL EROSION INVESTIGATIONS.
(b) Soil Conservation Service, U. S. Department of Agriculture.
(c) Data for calibration and design.
(d) H. L. Cook, D. A. Parsons, G. C. Conners.
(e) Chief, Soil Conservation Service.
(f) Calibration of divisors now in use; study of relative accuracy of various types; development of new divisors.
(g) Calibrations are being made on various divisors, both with clear and with muddy water, to determine the effectiveness of the divisor in splitting off a definite percentage of the water and soil passing it. The effects of various entrance conditions are being studied with a Geib divisor. All old types, modifications of the old types and some divisors of new design are being studied.
(h) Work has been completed on most of the older types of divisors. Various new forms have been developed and are being tested.

....

(341) (a) STUDY OF MEASURING FLUMES OF THE VENTURI TYPE.
(b) Soil Conservation Service, U. S. Department of Agriculture.
(c) Data for calibration and design.
(d) H. L. Cook, J. B. Drisko and L. DeFabritis.
(e) Chief, Soil Conservation Service.
(f) The development of improved devices for measuring the rate of runoff from plots used in the study of soil erosion.
(g) Tests are to be made of venturi-type flumes and control meters in an effort (1) to develop flumes with which more precise measurements of small flows may be obtained, and (2) to devise throat sections that will promote self-cleaning of the flumes.
(h) It was necessary to postpone this investigation for some time owing to lack of equipment and personnel. These have now been made available, and it is expected that tests will start in January, 1936.

....

(342) (a) STUDIES OF ARTIFICIAL CONTROLS FOR STREAM-FLOW MEASUREMENT.
(b) U. S. Geological Survey, Water Resources Branch.
(c) Cooperative project with U. S. Geological Survey for comparative performance tests and general scientific research.
(d) R. B. Hunter, H. N. Eaton, B. H. Monish and C. W. Elliot, (National Bureau of Standards). W. S. Eisenlohr, Jr. (Geological Survey).
(e) The Director, National Bureau of Standards.
(f) To study the relative merits of the various designs of several district offices of the Survey, with a view to standardizing on a few selected types.
(g) Full-scale sections have been tested in the 12 ft wide flume with flows ranging from 0.1 to 30 cfs. The tests included calibrations under free overfall conditions and with various degrees of submergence, also a study of the effect of the filling up of the channel above the control.

In addition to the above tests, a full-scale section 30 inches wide of an overflow dam at Wanaque, New Jersey, was tested at heads up to 2 ft. At a head of a little less than 2 ft there appeared to be a sudden break in the calibration curve, owing to a sudden change in the nature of the flow. In order to investigate this question further, a 1:6 scale model of this weir section was built and was tested in a small flume up to a head corresponding to about 3.5 ft on the full-size weir section. Above a head of about 0.1 ft on the model (0.6 ft on the full-size structure), the experimental points obtained with the model fell on the curve for the large weir within the limits of experimental error. The model gave the same break in the calibration curve as did the large weir.

Since the tests of the model Wanaque section agreed so well with the tests of the full-size section, a 1:6 scale model of the Asheville control tested in the large flume was also built and tested. Again the model data agreed closely with the data for the full-scale section.

In the tests of both models, pressures were measured at different points on the weir sections and the flow lines were made visible by the injection of dye. The change in the nature of the flow that caused the discontinuity in the calibration curve of the Wanaque section could be observed clearly in this way.
(h) A report on the tests of the full-scale control sections is now being prepared for the Geological Survey. A note on the model tests of the Wanaque and Asheville controls is being prepared for publication. A flume 10 inches wide and 20 inches high is being designed for continuing this study on small-scale models of the controls.

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(343) (a) ROUGHNESS IN PIPES.
(b) National Hydraulic Laboratory.
(c) General research.
(d) K. H. Beij, G. H. Keulegan, H. N. Eaton.
(e) The Director, National Bureau of Standards.
(f) Study of hydraulic roughness in pipes.
(g) Correlations of friction losses with surface of pipes.

(h) A "Glossary of Terms" has been completed and a chapter on "Laboratory Tests on Small Closed Conduits" is being prepared for the first report of the Committee for Research on Hydraulic Friction. (See section of this bulletin, "Hydraulic Research Committees".) It is expected that some experimental work will be done in the near future in connection with the study of pipe bends, Project 43.

(i) This investigation is carried on in connection with other projects as opportunity offers.

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(344) (a) EFFICIENCY OF WELL SCREENS.

(b) U. S. Geological Survey.

(c) General research.

(d) R. B. Hunter, B. H. Monish (National Bureau of Standards), and A. G. Fiedler (Geological Survey).

(e) A. G. Fiedler, U. S. Geological Survey.

(f) To determine the losses through well screens of a certain type.

(g) Tests of the efficiency of certain types of well screens previously tested in the field (See Project 265) at flows varying from 10 to 100 gallons per minute: (a) in clear water, and (b) in contact with a sand bed, pressure measurements being made in each test at various depths inside the well-screen and at the same depths outside the screen in contact with the sand bed. It is expected that these data will aid in correlating and interpreting the results of the field tests made by using Thiem's method.

(h) Flow lines and approximate flow rates were determined by observing travel of lines of dye through sand in a glass-sided two-dimensional model of the full-scale test apparatus. Pressure measurements made at this same time showed good correlation with the flow lines and rates. Large quantities of air coming out of solution in the water owing to the pressure drop in passing through the sand made it nearly impossible either to reach steady conditions or to simulate field conditions. The project has been postponed temporarily.

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(384) (a) TESTS OF SPILLWAY FLASHBOARD PINS.

(b) U. S. Forest Service.

(c) Cooperative project with the U. S. Forest Service for testing field designs under simulated field conditions in the laboratory.

(d) C. A. Wright and C. W. Elliot (National Bureau of Standards). C. A. Betts and F. L. Brown (U. S. Forest Service).

(e) The Director, National Bureau of Standards.

(f) To test spillway flashboard pins to failure under static water pressure and to compare the results with the values used in design.

(g) In addition to the tests made with the apparatus described in Bulletin III-2, tests were made of a large single panel flashboard 16 ft long and from 2 to 5 ft, in height, depending on the size of pins used, supported by two pins consisting of lengths of standard steel pipe. The deflections of the pins from the vertical were measured as the depth of the water upstream from

the flashboard panel was gradually increased until failure occurred. A total of 26 static and 5 overflow tests were made with pipes varying in diameter from 3/4 inch to 3 inches.

(h) It was found that the pins first deflected in proportion to the stress produced in them by the water load, then reached a definite yield point, and finally yielded much more rapidly than at first until failure occurred. The pipe failed by collapsing and bending through an angle of 90 degrees at the top of the socket in which it was set. The maximum deflection observed just before failure averaged 20 degrees and the computed stress at the section where failure occurred varied from 65,000 to 90,000 lb per sq inch. The depth of headwater required to produce failure agreed within 5 percent when pins of the same size and of the same materials were used. The experimental work has been completed, and the report is being prepared.

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(496) (a) DETERMINATION OF DISCHARGE COEFFICIENTS OF FLOW NOZZLES: COOPERATIVE RESEARCH PROJECT SPONSORED BY THE SPECIAL RESEARCH COMMITTEE ON FLUID METERS OF THE A.S.M.E.

(b) Factors for use in commercial measurements of fluids.

(c) Cooperative research.

(d) H. S. Bean, F. C. Morey.

(e) The Director, National Bureau of Standards.

(f) To determine discharge coefficients for a consistent series of "Long Radius" flow nozzles, so that similarly-made nozzles may be used without the need of individual calibrations in the commercial metering of fluids and in power plant tests.

(g) Water from a constant-head tank will be discharged through the flow nozzle into either a weighing or a volumetric tank for a measured interval of time. Readings of the differential pressures between 1, 2 or 3 pairs of pressure taps will be taken, from which the "calculated" rate of flow will be computed. The pressure tap locations that will be used are: in the corner of the nozzle flange and pipe wall, one pipe diameter upstream and in the nozzle throat, one pipe diameter upstream and opposite the nozzle throat. In some cases complete studies of the variations of pressure on both sides of the nozzle will be made. The rates of flow will be varied over as wide a range as can be obtained.

(h) Tests on several nozzles for 3-inch pipe are being made. Tests on other nozzles for 2-inch, 4-inch and 6-inch pipe will be made later when the nozzles are available.

(i) These tests on nozzles are only a small part of the complete program planned by the Fluid Meter Committee. All of the nozzles to be used in these tests will be tested in two or more other laboratories, in some of which steam, air or oil may be used as the fluid. The planning, supervision and reporting of the Flow Nozzle Research Program of the Fluid Meters Committee has been assigned to H. S. Bean of the National Bureau of Standards, Washington, D. C.

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(497) (a) METHODS FOR SAMPLING AND ANALYZING SOIL-WATER MIXTURES.
(b) Soil Conservation Service, U. S. Department of Agriculture.
(d) H. L. Cook, E. P. Dietrich, J. O. Laws.
(e) Chief, Soil Conservation Service.
(f) Determination of best methods of sampling and analysis from the standpoints of accuracy and efficiency.
(g) The methods that are now in general use and others that may suggest themselves will be used on synthetic mixtures of various concentrations of soils.
(h) Preliminary tests of the so-called "wt-vol" method of analysis have been made.

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UNIVERSITY OF CALIFORNIA, COLLEGE OF AGRICULTURE.

(270)(a) THE EFFECT OF DEPTH TO WATER TABLE UPON THE LOSS OF WATER FROM THE SOIL SURFACE. (Part of project on principles of soil moisture in relation to irrigation.)
(b) California Agricultural Experiment Station.
(c) Experiment Station project.
(d) M. R. Huberty and F. J. Veihmeyer.
(e) Professor F. J. Veihmeyer.
(f) This study is part of a larger project to determine losses of water through plant transpiration and surface evaporation.
(g) Twenty-five tanks holding more than one ton of soil, equipped with Mariott constant water-level regulating devices, are being used. The amount of water evaporated is determined volumetrically and gravimetrically. The investigations have been under way for several years. The experiments have been conducted in such a way that a statistical analysis of the results of evaporation from the surface of the soils with the water table a constant distance below the surface can be obtained.
(h) The experiments will be continued for several additional years.

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(271)(a) MOVEMENT OF MOISTURE THROUGH SOILS. (Part of project on principles of soil moisture in relation to irrigation.)
(b) California Agricultural Experiment Station.
(c) Experiment Station project.
(d) N. E. Edlefson and F. J. Veihmeyer.
(e) Professor F. J. Veihmeyer.
(f) This study is part of a general project to study movement of water in soils, both under saturated and unsaturated conditions. It also involved the movement of water to roots of plants, the energy relations involved by extraction of water by plants and the factors affecting availability of water to plants.
(g) Extensive equipment of plant containers with suitable arrangements for determining water use ranging from small cans to tanks containing over one ton of soil are being used. In addition, numerous field plots with permanently rooted and annual plants, together with a specially equipped laboratory for the study of different phases of soil moisture movement, are in use.
(h) In progress.

....

(272)(a) CHARACTERISTICS OF SPRINKLERS AND SPRINKLER SYSTEMS FOR IRRIGATION. (Part of larger project on farm irrigation structures and systems.)
(b) California Agricultural Experiment Station.
(c) Experiment Station Project.
(d) J. E. Christianson.
(e) Professor F. J. Veihmeyer.
(f) Determination of factors affecting uniformity of distribution, evaporation losses, and frictional losses in pipe lines with multiple outlets.
(g) Approximately 100 tests have been made on sprinklers of different makes and types to determine the distribution of water under varying conditions. Water is caught in a large number of cans (rain gages) and evaporation losses estimated from average depth caught as compared with water discharged. Effect of wind, pressure, speed of rotation of sprinkler, temperature, humidity, and various combinations of nozzles on performance of sprinklers studied. A large number of tests have been made on portable sprinkler pipe with sprinklers spaced at definite intervals to determine net pressure losses.
(h) In progress.

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CALIFORNIA INSTITUTE OF TECHNOLOGY.

(102) (a) INVESTIGATION OF VELOCITY DISTRIBUTION IN THE VOLUTE OF A CENTRIFUGAL PUMP IN THE NEIGHBORHOOD OF THE IMPELLER.
(b) Laboratory problem.
(c) General research for thesis for M.S. degree.
(d) R. C. Binder.
(e) Professor R. L. Daugherty, or Professor Robert T. Knapp.
(f) By a special instrument the magnitude and direction of the velocity of the water is measured at a number of points within the volute, thus supplying experimental information that has long been desired.
(g) The scope of this research has been enlarged to include the determination of the magnitude and direction of the instantaneous velocities as well as the average values. For this purpose a precision dual slide valve has been constructed which together with a phase shifting device permits of the measurement of the instantaneous values at any desired position of the impeller. To date the apparatus has been successfully operated over 2000 rpm.
(h) Continued. A preliminary report has been presented by Mr. R. C. Binder and information concerning it can be obtained from him or from Professor Knapp.

....

(356)(a) STUDY OF CHARACTERISTICS OF HIGH HEAD CENTRIFUGAL PUMPS.
(b) Metropolitan Water District of Southern California.
(c) Large scale model study.
(d) Professors Th. von Kármán, R. L. Daugherty, and Robert T. Knapp for the California Institute of Technology, Mr. R. M. Peabody for the Metropolitan Water District, plus staff of assistants.
(e) Same as (d).

(f) To determine the most advantageous types, speeds and operating conditions of the large centrifugal pumps to be used on the Colorado River Aqueduct.
(g) Brief description of the laboratory equipment given in National Bureau of Standards Hydraulic Laboratory Bulletin Series B, "Hydraulic Laboratories in the United States", October 1, 1935.
(h) Laboratory was placed in operation September, 1934. To date, five pumps of varying types and specific speeds have undergone exhaustive tests. (as of July 1, 1935.)

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(357) (a) INVESTIGATION OF HIGH VELOCITY FLOW AROUND BENDS IN OPEN CHANNELS.
(b) Los Angeles County Flood Control District.
(c) Cooperative study with Los Angeles County Flood Control District through C. H. Howell, Chief Engineer.
(d) Professor Robert T. Knapp, with Arthur Ippen and Warren E. Wilson, assistants.
(e) Professor Robert T. Knapp.
(f) To determine the most advantageous construction for curved channels with flow velocities above the critical, such as encountered in flood control channels from foothill areas.
(g) A special high velocity flume is being constructed for this work. Experiments will be conducted in channels of various cross sections and radii of curvature with grades up to 12 percent and rates of flow up to 5 cfs.
(h) Apparatus under construction. Experimental work will be under way in July, 1935.

....

(358)(a) A STUDY OF SURGE WAVE PROPAGATION AND TRAVEL IN CHANNELS OF STEEP GRADIENT.
(b), (c), (d) and (e) Same as for Project (357).
(f) One type of steady flow in channels of steep gradient is as a series of surge waves. This may be the determining factor in the necessary free board on open channels. This experiment is for the purpose of further investigating conditions under which such flow takes place and the height and wave length of the waves produced.
(g) Equipment and apparatus used for Project 357 will be modified for this study. In this investigation it is planned to employ "slow motion" moving pictures as an aid to the study of the velocity and change of shape of the waves.
(h) Methods and apparatus are now being developed. Experimental work probably will be started in September, 1935.

....

(359)(a) STUDY OF THE SPEED OF PROPAGATION OF FLOOD HYDROGRAPHS IN CHANNELS OF VARIOUS GRADIENTS.

(b),(c), (d) and (e) Same as for Project (357).

(f) A knowledge of the rate of travel of flood flows is necessary for rational design of flood control systems. In some cases of high velocity channels further information would be valuable. This project is for the purpose of further investigation of this subject.

(g) Equipment and methods used in Project (358) will also be employed for this study, supplemented by auxiliary apparatus for the production of desired flood hydrographs.

....

(360)(a) FUNDAMENTAL INVESTIGATIONS OF THE HYDRAULIC PHENOMENA INVOLVED IN SOIL EROSION.

(c) Cooperative research program with Soil Conservation Service. Mr. H. H. Bennett, Chief, U. S. Department of Agriculture.

(e) Professors Th. von Kármán and Robert T. Knapp.

(i) This program is just being initiated and therefore is not yet in the state where it can be separated into specific projects.

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UNIVERSITY OF MINNESOTA.

(94) (a) TRANSPORTATION OF SEDIMENT.

(b) University of Minnesota Engineering Experiment Station.

(c) University hydraulics research project.

(d) Lorenz G. Straub and graduate assistants.

(e) Professor Lorenz G. Straub.

(f) Investigations of transportation of bed sediment in alluvial rivers and the effect of contraction works on the river channel.

(g) Preliminary experiments were conducted in a wooden flume about 35 ft long, 12 inches wide, and 18 inches deep, sediment being added at the entrance to the flume and collected and weighed at the point of discharge. Water discharge was measured by means of a weir located at the entrance to the flume. Additional experiments are in progress using a specially designed steel tiltable flume about 60 feet long, 3 feet wide, and 15 inches deep. Sediments of various mechanical compositions are being used; some of the materials have been taken directly from the beds of midwestern rivers. Observations are made of the rate of sediment transportation for various flow conditions, the character of the riffle formations, the effect of channel contraction works on the regimen of the stream bottom, etc.

(h) Investigation in progress.

....

(99)(a) LAWS OF HYDRAULIC SIMILITUDE.

(b) University of Minnesota Engineering Experiment Station.

(c) University hydraulics research project.

(d) Lorenz G. Straub and graduate assistants.

(e) Professor Lorenz G. Straub.

(f) Investigations of the limitations of the laws of hydraulic similitude.

(g) In connection with various research projects of the hydraulics laboratory in which models are used, wherever possible studies are being made on models of several different scales. The results recorded are being generalized to develop numerical limitations of the various laws of hydraulic similitude.
(h) In progress.

....

(190)(a) FLOW CONDITIONS IN OPEN CHANNEL.
(b) University of Minnesota Engineering Experiment Station.
(c) University hydraulics research project.
(e) Professor Lorenz G. Straub.
(f) To determine conditions of laminar and turbulent flow in open channels.
(g) Flow conditions are observed in a small tiltable flume.
(h) Preliminary set of experiments completed; further studies are being undertaken with an improved type of apparatus.

....

(327)(a) EXPERIMENTAL STUDY OF FLUSH VALVES FOR WATER-CLOSETS.
(b) Minnesota State Board of Health.
(c) Cooperative research project with Sanitary Division of Minnesota State Board of Health and the Hydraulics Department of the University.
(d) Lorenz G. Straub, H. A. Whittaker, Jack J. Handy.
(e) Professor Lorenz G. Straub.
(f) Investigation of the suitability of various types of flush valves particularly with the view of determining possibilities of back-siphoning into fresh water lines.
(g) A standard water-closet bowl is so arranged that the discharge variation may be recorded graphically. The set-up permits using various types of flush valves. Wide variations in pressure are possible on the feed water line.
(h) In progress.

....

(328)(a) EXPERIMENTAL STUDY OF SEDIMENTATION BASINS.
(b) University of Minnesota Engineering Experiment Station.
(c) Graduate research project.
(d) Alvin Anderson.
(e) Professor Lorenz G. Straub.
(f) Determination of flow conditions in water works sedimentation reservoirs by means of models.
(g) Models of entrance and exit structures are built into a glass-sided channel in such a manner that flow conditions can be controlled. Finely divided solid material of low specific gravity is added to the water at the entrance to the model basin so that sedimentation and flow conditions can be observed.
(h) Preliminary experiments completed. Report in progress.

....

(329)(a) STUDIES OF HYDRAULIC JUMP.
(b) University of Minnesota Engineering Experiment Station.
(c) Graduate research project.
(d) Harold Flinsch.
(e) Professor Lorenz G. Straub.
(f) Experimental study of mechanical occurrences within hydraulic jump.
(g) A glass flume 20 inches wide and 27 inches deep is arranged to provide various conditions of shooting and streaming flow. Measurements are made of the velocities, pressures, etc., within the jump.
(h) Experiment is in progress.

....

(365)(a) MODEL TESTS FOR EROSION.
(b) Northern States Power Company.
(c) Cooperative research with Northern States Power Company.
(d) George E. Loughland and Lorenz G. Straub.
(e) Professor Lorenz G. Straub.
(f) Investigation of erosion below tainter gates at St. Cloud, Minnesota, on the Mississippi River and Experimental design for improvements of apron to reduce scour.
(g) Experiments conducted on small-scale wooden models built into glass flume.
(h) Experimental series completed. Revisions being made in actual structure.

....

(366)(a) LABORATORY DESIGN AND ANALYSIS OF SPILLWAY CREST.
(b) Northern States Power Company.
(c) Cooperative research with Northern States Power Company.
(d) George E. Loughland and Lorenz G. Straub.
(e) Professor Lorenz G. Straub.
(f) Analysis by means of models of various proposed revisions and extensions of the spillway crest of a dam at Cedar Falls, Wisconsin.
(g) Studies consisted of determining the pressure distribution of models of the proposed and also the existing spillway crest. Studies were also made to determine a suitable design for the tumble bay of an added section of spillway.
(h) Laboratory studies have been completed.

....

(367)(a) EXPERIMENTAL ANALYSIS OF SOIL EROSION CONTROL PROJECTS.
(b) Agricultural Experiment Station, University of Minnesota.
(c) Cooperative project with Department of Agricultural Engineering, University of Minnesota.
(d) Harry B. Roe and Lorenz G. Straub.
(e) Professor Lorenz G. Straub.
(f) Experimental analysis of capacity and of flow conditions through a particular control structure by means of observations on a laboratory model.

(g) A model constructed of wood, glass, and plaster of Paris, containing the essential features of the layout, such as the culvert, dam, and approach channel, was provided in the laboratory. Observations were made of flow conditions and various rates of discharge.
(h) Preliminary laboratory experiments have been completed and changes are to be made in the actual structure.

....

(369) (a) EXPERIMENTAL ANALYSIS OF COFFERDAM DESIGN.
(b) Mr. Lazarus White.
(c)
(d) Lorenz G. Straub and laboratory assistants.
(e) Professor Lorenz G. Straub.
(f) Experimental analysis of design for proposed cofferdam.
(g)
(h) In progress.

....

NEW YORK UNIVERSITY.

(130)(a) DURATION CURVES OF STREAM FLOW.
(c) General scientific research and in connection with theses for Master's degrees.
(d) Thorndike Saville, graduate students, and assistants.
(e) Professor Thorndike Saville.
(f) To determine regional characteristics of stream flow and the applicability of statistical methods to its analysis.
(g) Construction of duration curves of weekly stream flow in terms of mean flow. Deviations of curves from one another as influenced by drainage areaand regional characteristics and length of record. Construction of composite curve applicable to a region. Statistical analysis of curves and data.
(h) Study of five North Carolina Streams completed and published. See Bulletin III-1 or III-2.

....

(131)(a) ESTIMATING FLOOD FLOWS.
(b) General scientific research and in connection with theses for Master's degree.
(d) Thorndike Saville, graduate students, and assistants on work relief.
(e) Professor Thorndike Saville.
(f) (g) To compare all the various methods which have been proposed by applying them to streams having long periods of flow, and to develop if found desirable, improved methods.
(h) See Bulletin III-1 or III-2.

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COMPLETED PROJECTS.

1. ABSTRACTS.

CORPS OF ENGINEERS, U. S. ARMY, ZANESVILLE DISTRICT.

(428) MODEL STUDY OF WILLS CREEK DAM.

The object of this study was to determine the performance of the preliminary design, to improve the design where necessary and to determine the operation of the final design. A preliminary model to an undistorted scale of 1:36.8 was constructed to crsytalize the design to where fewer adjustments would be necessary on the more costly final model. The final model was constructed to a scale of 1:25, reproducing the approach conditions to inlet structure, the twin tunnels with a cross-connection below the gate structure, stilling basin and outlet channel. The approach channel and stilling basin were constructed of cement mortar and the tunnels of 16 gauge sheet metal. Below the stilling basin, the channel was molded of sand so that a qualitative determination of the effectiveness of the stilling basin could be made. Various combinations of apron floor, sills and side walls for the stilling basin were tried out in the preliminary model.

As a result of the final model test; it was determined that in general the design was satisfactory with certain modification. The results obtained in the operation of the very complicated transition section below the gate structure showed that the hydraulic design for this structure was highly efficient. Valuable principles in the handling of the high discharges under varying tailwater conditions were determined. The tests indicated that the flare below or from the outlet portal should not exceed 1:4 and that the batter of the flaring side walls should be approximately 10 on 1 for good distribution of the high velocities of the issuing jets.

(429) MODEL STUDY OF CHARLES MILL DAM.

Two models were constructed for this study. The first model was constructed to a 1:20 scale, reproducing the outlet structure consisting of five 3-1/2 ft x 7 ft conduits through the base of an ogee gravity-type dam. The spillway above the conduits was also included in this preliminary study. The stilling basin and outlet channel were also reproduced. Tests on this model covered the various shapes and sizes of conduit openings, entrance shapes, location of baffle piers, shape of terminal sill and performance of the conduits and spillway discharging in combination. The studies indicated that the rectangular shape conduits produced the best results for good performance of the stilling basin. The final model was constructed to a scale of 1:30, reproducing the approach conditions to the conduits and secondary spillway, the series of steps below the secondary spillway parallel to the direction of discharge, the stilling basin and outlet channel. The results from this model indicated good performance of the secondary spillway by gradually turning the benches below on a smooth curve into the outlet channel. A satisfactory hydraulic jump was obtained

by use of baffle blocks below the discharges from the five independent conduits. For the velocities which obtained from these tests, a flare of the side walls below the conduits greater than 1:5 or 1:4 or a batter less than 1:10, seems to be undesirable. The test indicated that baffle piers assist in distributing the high velocities but do not counteract fully the condition of the unequal distribution with unsymmetrical gate openings. The test indicated that best performance was obtained with the gates open symmetrically on each side of the center conduit. The terminal sill at the end of the apron appears to be of service in reducing bottom velocities and forming a backroller downstream. Discharge curves were obtained for the secondary spillway with the approach channel 2 ft below the crest and 7 ft below the crest. The test showed a material increase in the discharge of the secondary spillway with the deeper approach channel.

(430) MODEL STUDY OF TAPPAN DAM. The model study was confined to the stilling basin. Part of the outlet tunnel and exit portal were reproduced in order to simulate flow conditions into the stilling basin. The elevation of the tunnel was fixed by the necessity of getting it in a satisfactory stratum of hard sandstone. This resulted in a tailwater which, under certain conditions, was so high as to drown out the hydraulic jump. It was found necessary in order to get away from the effects of drowning the hydraulic jump, to provide a hump in the floor of the stilling basin just below the outlet. This is a rather unorthodox design but the model experiments showed that it produced good formation of the hydraulic jump under conditions where it was previously drowned. A slot is provided through this hump so that the tunnel may be drained for repair purposes. The tests covered various sizes of stilling basin for this particular structure and indicated that liberal size alone is insufficient guarantee of good performance. Observations were also made on the performance of the hydraulic jump under various tailwater elevations.

(431) MODEL STUDY OF CLENDENING DAM.

The purpose of the tests was to examine the performance of the preliminary design of the tunnel outlet portal and stilling basin, erected to a scale of 1:20 and to develop improvements to this design.

The tests extended over several successively improved layouts, with measurements including hydraulic gradients, velocity traverses below the hydraulic jump, scour in the model channel, and other pertinent data; by which performance was determined under stipulated rates of discharge and variation in tailwater stage.

The tests indicated best performance with a basin of the same general type as originally set up, but shorter, with lesser flare and batter to the sidewalls, and other dimension changes. An important improvement was the use of a sharply rising invert or hump in the tunnel near the portal by which the problem of high tailwater was overcome, where the tunnel itself had to remain at a relatively low elevation. Profiles and visual observations of the formation of the hydraulic jump under varying tailwater conditions are obtained.

(432) MODEL STUDY OF PIEDMONT DAM.

The purpose of the tests was to examine performance of a model of the tunnel, outlet portal and stilling basin, erected to a scale of 1:25 in accordance with preliminary design, and to develop improvements to this design.

Measurements on the model included hydraulic gradients, velocity traverses below the hydraulic jump, scour in the model channel, and other data by which performance was determined under stipulated rates of discharge and variation in tailwater stage.

The Piedmont Outlet Works incorporates substantially the same features included in the Outlet Works for the Tappan and Clendenning Dams. The preliminary design was predicated to a certain extent on experience previously gained in testing models for these two dams, and only minor revisions were found to be necessary. These revisions consisted solely of shortening the stilling basin by 15 feet, and placing the terminal sill at the extreme downstream end of the apron. Visual observations of the performance of the hydraulic jump under varying tailwater conditions were obtained.

(433) MODEL STUDY OF DOVER DAM.

The purpose of the studies was to examine the performance of the preliminary design of an ogee gravity-type dam with 3 batteries of outlets at various elevations through the base of the dam. Sufficient depths for the proper formation of the hydraulic jump could not be provided on the apron below the center and left batteries without excavating into the rock layer, which, for structural reasons, was to be left undisturbed. The problem then became one of securing good formation of the hydraulic jump by use of baffle piers. In addition, the purpose of the studies was to examine the performance of a model erected to a scale 1:35, of the ogee spillway section, outlet conduits through it and stilling basin below. The preliminary design first erected was revised in accordance with findings which indicated needed improvements for proper performance. Discharge curves were obtained for each battery separately and in combination.

The test included measurements of hydraulic gradients, velocity traverses below the hydraulic jump, scour in the model channel, spillway behavior and observations on the formation of the hydraulic jump with various locations of the baffle piers.

(434) MODEL STUDY OF MOHAWK DAM.

The purpose of the tests was to examine the performance of a model of the intake structure, twin tunnels, and stilling basin, erected to a scale of 1:40 in accordance with the preliminary design as furnished by the Zanesville Office, and to develop improvements to this design.

The tests extended over several successively improved layouts, with measurements including hydraulic gradients, velocity traverses below the hydraulic jump, scour in the model channel, and other pertinent data; by which performance was determined under stipulated rates of discharge and tailwater stage.

The tests indicated that the elevation of the tunnel invert at the portal should be raised in order to secure good formation of the hydraulic jump for the lower discharges, that the cross-sectional area of the flared portal should be reduced to eliminate high negative pressures indicated by test of preliminary design, that the cross connection between the twin tunnels was not as efficient in distributing the discharge with unbalanced gate openings as the Wills Creek design, owing to the higher velocities existing at Mohawk, that the stilling basin might advantageously be shortened, that a stepped-face terminal sill was more effective than short piers at the end of the stilling basin, that certain adjustments should be made to the transition between the stilling basin and the channel below, and that the capacity of the outlet works was adequate for proposed operation.

(435) MODEL STUDY OF BOLIVAR DAM.

The purpose of the tests was to examine the performance of the proposed design by means of a model of the twin intake structure, tunnels, and stilling basin, erected to a scale of 1:40, to calibrate the model for discharge capacity, and to record its action under a wide range of tailwater level.

The tests included the measurement of hydraulic gradients, velocity traverses below the hydraulic jump, scour in the model channel, and other pertinent observations by which performance was determined under stipulated rates of discharge and tailwater variation.

The tests indicated that the proposed design was satisfactory, that certain precautions might well be observed in operating the gates to minimize disturbances from air within the tunnels, and that the capacity of the outlet works was adequate for proposed operation.

(436) MODEL STUDY OF SENECAVILLE DAM.

The purpose of the studies was to examine the performance of the preliminary design by means of a model erected to a scale of 1:20, of the outlet tower, with sluice and Taintor gate controls, the outlet channel, and the stilling basin. The preliminary design first erected was revised in accordance with findings which indicated needed improvements for proper performance and the final model was calibrated for discharge capacity and tested for the range of operation intended.

Tests included the measurement of hydraulic gradients, velocity traverses below the hydraulic jump and scour in the model channel. Discharge curves were obtained for both the sluice gates and Taintor gates. The tests indicated that the slope of the outlet channel should be decreased from the preliminary value of 1 percent to a value of 0.5 percent, that the benches receiving released water over the Taintor sills should be raised and reshaped to provide transition to outlet channel and that the stilling basin might be advantageously revised in certain particulars. All of these changes were for the common purpose of securing better distribution of flow in the outlet channel, and providing a stilling basin less sensitive to fluctuations in tailwater level for a given discharge.

(437) MODEL STUDY OF MOHICANVILLE DAM.

The purpose of the studies was to examine the performance of the preliminary design by means of a 1 to 25 scale model of the outlet conduits, outlet channel between conduits and stilling basin, stilling basin, and a secondary side-channel spillway normal to the dam, to discover needed improvements to the design, and to check the performance of the final model so developed.

Tests included measurement of hydraulic gradients, velocity traverses in the stilling basin and below, spillway behavior, and other pertinent observations. Visual observations and the tests indicated that the side-channel spillway of the preliminary design should be superseded by an ogee section with axis parallel to the dam similar to that of Charles Mill Dam, and located at the left abutment, that the outlet channel between the conduit portals and the stilling basin should be eliminated, and that the location of the gate tower and stilling basin should be changed, with incidental revisions to several features. The substantial changes made in the outlet structure were principally aimed to secure positive action of the hydraulic jump in the stilling basin for the several discharges required for operation and coincident tailwater level in the channel below. Better operating conditions obtained with balanced gate operation.

(438) MODEL STUDY OF PLEASANT HILL DAM.

The purpose of the studies was to examine the performance of the proposed design by means of a 1:50 scale model of outlet portal and stilling basin only and by means of a 1 to 30 scale model, consisting of gate tower with sluice gates for blowoff of the reservoir, continuously open orifices in the sides of the gate tower for automatic control of reservoir stage, with morning glory overflow crest and shaft spillway for higher floods, and with outlet tunnel and stilling basin. Improvements were developed in the preliminary design, and the revised model was calibrated for capacity of the several outlets and observed for performance with a view toward safety in action. Temporary diversion intakes for service during construction were also part of the study.

Tests included measurements of hydraulic gradients, water-surface nappe over the spillway, flow through the diversion intakes, orifices, sluice gates, spillway and tunnel, and in the stilling basin. Conditions of flow not subject to measurement were photographically recorded. Tests indicated that the preliminary design had excess capacity and that consequently the tunnel size could be reduced; that the tunnel invert at the portal must be raised for proper performance of the stilling basin; that certain elements of the stilling basin should be changed; that with the revisions indicated the structure had adequate capacity for the operation to be expected, and would be safe in operation.

NATIONAL BUREAU OF STANDARDS.

(129) TRANSPORTATION OF SEDIMENT, COLORADO RIVER.

The purpose of this investigation was to determine the difference in the scour produced in a bed of fine sand by muddy water, as contrasted with clear water, in attempted simulation of the conditions existing in the Colorado River below the site of the Boulder Dam before and after construction.

A tilting flume 40 ft long, 20 inches wide and 18 inches high was used for the experiments. The sand bed was 8 ft long. Sand from the Colorado River was used, as well as local coarser sands. The suspended load of the river was simulated by Georgia kaolin, comparable in particle size with the suspended load of the river.

The sand bed was first settled under water, then water was allowed to flow over the bed under the desired conditions for one hour, no additional material being added upstream from the test bed to replace the sand scoured and carried away. The amount of scoured material, the amount of clay in suspension, the conditions of flow and the appearance of the bed were noted, and samples of the material scoured and the suspended load were analyzed.

It was found that when the water contained an appreciable amount of clay in suspension, an increase of about 10 percent in mean velocity over that of the clear water was required to produce the same amount of scour for the Colorado sand. For the coarser sands, this increase was considerably greater. It was also shown that a very considerable increase in scour resulted from a small increase in mean velocity above that necessary to start scour. Values of critical tractive force and mean and bed velocity were determined for "general movement" when the sand grains were just beginning to move in the form of riffles.

Sand	Average diameter microns	Kaolin in suspension percent	Critical values		Higher values	
			Mean velocity fps	Tractive force lb/sq ft	Bed load scoured lb/sq ft/hr	Corresponding mean velocity fps
Local)	384	clear water	1.2	0.0088	1.5	1.23
sand)	398	2.7	1.4	0.0125	1.5	1.53
Colorado)	107	clear water	0.8	0.0077	0.6	0.90
sand)	109	1.4	0.9	0.0087	0.6	0.98

Although the laboratory investigation can not be applied quantitatively to the Colorado River, it is concluded that there will be more scour and resulting transportation of the river bed by clear water if this is discharged from the dam, than was the case with muddy water.

COMPLETED PROJECTS.

II. PUBLICATIONS.

CORNELL UNIVERSITY

(288) LOSS OF HEAD DUE TO BENDS, TEES AND CROSSES AS USED IN WATER WORKS PRACTICE.

Loss of head due to Long (present A.W.W.A. standard) and Short Body Bends, Tees and Crosses; also Economic Comparison. The results have been published in Bulletin No. 20, Cornell University Engineering Experiment Station. Price $1.25.

THE OHIO STATE UNIVERSITY.

(134) and
(135) A DETERMINATION OF THE COEFFICIENTS OF COMMERCIAL METERING ELEMENTS FOR STEAM AND WATER, and

A STUDY OF THE FLOW OF WATER THROUGH ORIFICES IN VARIOUS SIZED PIPES.

The results of these investigations are given in Engineering Experiment Station Bulletin 89, "The flow of water through orifices", by S. R. Beitler. A study in 1, 1-1/2, 2, 3, 6, 10 and 14 inch lines. Available upon request.

U. S. GEOLOGICAL SURVEY, Water Resources Branch.

(26) PERMEABILITY TESTS CONDUCTED UNDER VERY LOW HYDRAULIC GRADIENTS.

The results of this investigation are presented in a paper: "Further tests of permeability with low hydraulic gradients", by V. C. Fishel, Transactions of the American Geophysical Union, 1935, Part II, pp. 499-503.

U.S. WATERWAYS EXPERIMENT STATION.

Technical Memoranda and Research Memoranda have been prepared for all completed studies and for all completed phases of any study now listed as "in progress". Loan copies of these papers may be obtained by writing to the Director, U. S. Waterways Experiment Station, Vicksburg, Mississippi.

REFERENCES TO PUBLICATIONS.

IOWA INSTITUTE OF HYDRAULIC RESEARCH.

Selected list of recent publications dealing with work of the Iowa Institute of Hydraulic Research. A limited number of reprints indicated by asterisk (*) are available, and as long as the supply lasts copies may be obtained by addressing Prof. F. T. Mavis, Associate Director in Charge of Laboratory, Iowa Institute of Hydraulic Research, Iowa City, Iowa.

Descriptive.

(*) "Hydraulic Research at Iowa University", by F. T. Mavis, ENR, Sept. 26, 1935, pp. 433-437 (Includes selected list of publications.)

Measuring devices and calibration.

"Velocity Tube in Use in Iowa Laboratory," by Charles B. Spencer, Civil Engineering, Sept. 1935, p. 488.

Flow in Open and Closed Conduits

(*) "The Capacity of Creosoted Wood Culverts Studied," by F. T. Mavis, ENR Oct. 18, 1934.

"Flow of Water Around Bends in Pipes," by D. L. Yarnell and F. A. Nagler, Transactions, Am. Soc. C. E., Vol. 100, pp. 1018-1043.

"Flow Around a River Bend Investigated," by F. L. Blue, Jr., J. K. Herbert, and R. L. Lancefield, Civil Engineering, Vol. 4, pp. 258-260, May, 1934.

"The Hydraulic Jump in Terms of Dynamic Similarity," Discussion by Nolan Page, Proceedings, Am. Soc. C. E., Sept. 1935, pp.1098-1102, and by F. T. Mavis and A. Luksch, loc. cit., pp. 1103-1106.

Piers and Channel Obstructions

"Bridge Piers as Channel Obstructions," by D. L. Yarnell, Technical Bulletin 442, U.S.Department of Agriculture, 1934. (For sale by Superintendent of Documents, Washington, D. C. 10 ¢)

"Pile Trestles as Channel Obstructions," by D. L. Yarnell, Technical Bulletin 429, U.S.Dept. of Agriculture, 1934. (For sale by Superintendent of Documents, Washington, D. C. 10 ¢)

Transportation of Detritus

"The Transportation of Detritus by Flowing Water-I," by F. T. Mavis, Chitty Ho, and Yun-Cheng Tu, University of Iowa Studies in Engineering, Bulletin 5, 1935. (50 ¢)

Hydrologic Studies

"Stream Gaging Research in Iowa," ENR July 26, 1934.

(*)"An Analysis of Unusual Rainfall Records in Iowa," by F. T. Mavis and J. W. Howe, Journal, American Water-Works Association, Vol. 27, pp. 174-190, February, 1935.

(*)"The Frequency of Intense Rainfall in Iowa," by F. T. Mavis and D. L. Yarnell, Bulletin of the Associated State Engineering Societies, October 1935, pp. 46-52.

"Stream Flow Records of Iowa, 1873-1932," Prepared in cooperation with the Water Resources Branch of the U. S. Geological Survey and the Iowa Institute of Hydraulic Research and published by the Iowa State Planning Board, 1935. (568 pp.)

"Frequency of Intense Rainfall in Iowa Analyzed," ENR Aug. 8, 1935, pp. 190-191.
"Rainfall Intensity-Frequency Data," by D. L. Yarnell, Miscellaneous Publication No. 204, U.S. Department of Agriculture. (For sale by Supt. of Documents, Washington, D. C. 10 ¢)

Flood Control

(*) "A Slide Rule for Flood-Routing Computations," by C. J. Posey, ENR, April 25, 1935.

Hydromechanics and Analysis

"Ideal Running Speed for Pelton Wheels," by C. J. Posey, Civil Engineering, Vol. 4, pp. 368-369 (July 1934).

PENNSYLVANIA WATER & POWER COMPANY.

"Cavitation and erosion investigated as a problem in fluid mechanics", by W. Watters Pagon. Preprint issued by the Pennsylvania Water and Power Company. Copy in the files of the National Hydraulic Laboratory available for loan.

U. S. GEOLOGICAL SURVEY, Water Resources Branch.

A bibliography of permeability and laminar flow has been compiled recently. Copies may be borrowed by writing to O. E. Meinzer, Geologist in Charge, Division of Ground Water, U. S. Geological Survey, Washington, D. C.

NATIONAL RESOURCES COMMITTEE.

A report entitled "Standards and Specifications for Hydrologic Data", prepared by the Special Advisory Committee to the Water Resources Committee was issued by the National Resources Committee under data of November 6, 1935.

SECTION OF HYDROLOGY, AMERICAN GEOPHYSICAL UNION.

Transactions of the American Geophysical Union, Part II, Reports and Papers of the Section of Hydrology, Published by the National Research Council of the National Academy of Sciences, Washington, D. C., August, 1935.

Copies of this publication may be purchased at the price of $1.50 (postpaid) from the General Secretary, American Geophysical Union, 5241 Broad Branch Road, N. W., Washington, D. C. Checks should be made payable to the "American Geophysical Union".

Contents:

Reports of Committees on Snow, Glaciers, Evaporation, Absorption and Transpiration, Rainfall and Runoff, Physics of Soil Moisture, Underground Waters, Dynamics of Streams, Chemistry of Natural Waters.

Contents (continued).

Papers:

The flow of water in thin sheets - M. R. Lewis and E. H. Neal.
Outline of the energetics of stream-transportation of solids - Howard L. Cook.
Some observations of sorting of river sediments - Lorenz G. Straub.
Diversity of current-direction and load-distribution on stream bends. Henry M. Eakin.
Some relationships between slope-length, surface-runoff, and the silt-load of surface-runoff. G. W. Musgrave.
Distribution of silt in open channels. J. E. Christiansen.
Models of estuaries. Morrough P. O'Brien.
A sedimentation-study on Clearwater River, Idaho. John P. Thomson.
A state-wide program of periodic measurements of ground-water level in Nebraska. L. K. Wenzel.
The need for a nation-wide program of observation-wells. O. E. Meinzer.
Further tests of permeability with low hydraulic gradients. V. C. Fishel.
Ground-water studies in the humid and semiarid parts of the Texas Coastal Plain. S. F. Turner and Penn Livingston.
Evaporation from large water-surfaces based on records in California and Nevada. S. T. Harding.
Bank storage-loss and recovery of Missouri River discharge during drought of 1934. H. C. Beckman.
The use of the Burt phototube in an integrating pyrheliometer. N. W. Cummings.
The relation between the lowering of the piezometric surface and the rate and duration of discharge of a well using ground-water storage. Charles V. Theis.
The piezometric surface of artesian water in the Florida Peninsula. V. T. Stringfield.
Preliminary report on periodogram-analysis of the rainfall-records of the Pacific Coast of North America. Dinsmore Alter.

TRANSLATIONS.

The following translations have been made at the University of California with SERA and FERA assistance. Copies have been filed in the Hydraulic Laboratory Section at the National Bureau of Standards.

Forthmann, E., Gottingen - "About turbulent diffusion of flow lines", Ingenieur Archiv, Band V, Heft 1, February 1, 1934.

Stefan, M. J. - "Experiments on the evaporation from open tubes of circular or elliptical form". Sitzungsberichte der K. K. Akad. Math.- Naturv. Klasse, Vol. 83, 1881.

Stefan, M. J. - "Experiments on evaporation." Sitzungberichte der K. K. Akad. Math.-Naturv. Klasse, Wien, Vol. 68, Part 2.

Wagner, A. -"The problem of evaporation", Gerland's Beitrage zur Geophysik, Vol. 34, 1931.

Leroux, P. - "Determination of the coefficient of the flow of nozzles and submerged orifices", Annales des Mines ou Resueil, Treizieme Serie, Tome IV, II Livraison de 1933.

Kopp, Dr. Ing. - "Recent flow experiments", Gesellschaft der Förderer der Hannoverschen Versuchsanstalt für Grundbau und Wasserbau, Heft 14, 1933.

Schoklitsch, A. - "Shearing force and bedload movement." 1914.

Tylvad, K. - "Graennsevaerdier for Vandets Hastighed ved Strømmende Vandbevaegelse." (Critical values for water velocities in streaming flow). Ingeniøren, 1928.

Goede, Reg.-Baurat - "Der Kortsche Düsenschlepper." (The Kort canal tugboat with internal propeller). Gesellschaft der Förderer der Hannoverschen Versuchsanstalt für Grundbau und Wasserbau, Heft 14, 1933.

Busmann, Dr. Eng. Fritz - "Efficiency improvements by means of encased ship propellers". Werft-Reederei-Hafen, Heft 3, February, 1934.

Vitols, A. - "Roughness." Latvijas Universitates Raksti, Acta Universitatis Latvienis, Mechanikas Facultates, Serija 1, 3, Riga, 1930.

Kasai, Taijiro - The effect of the size and shape of passages of guide vanes upon the characteristics of a high pressure single stage centrifugal pump. Journal of the Society of Mechanical Engineers, Japan, Vol. XXXV, No. 183, July, 1932.

Ritter, Carl - "Self-priming Centrifugal Pumps", etc., 1930.

Jönson, Fredrich - "On Stabilitetsvilkoret vid Utjamningsbessonger" (Conditions for the stability of surge chambers). Teknisk Tidskrift, March 24, 1928.

Lindquist - "Discharge through a waterway". Teknisk Tidskrift, January, 1928.

Lindquist - "Effect of inclination on current meters". Teknisk Tidskrift, April 17, 1926.

Ekwall - "Hydraulic structures laboratories" (A review of "Hydraulic Laboratory Practice", edited by John R. Freeman.) Teknisk Tidskrift, December 25, 1926.

Lindquist - Om Missvisningen hos Hydrometriska Flygler", (On the errors of current meters). Teknisk Tidskrift, February 19, 1927.

Lindquist - "Calibration of Current Meters", Teknisk Tidskrift, October 18, 1924.

Fellenius - Ekonomisk Beräkning av Pumpledningar. (Computation of the economics of pipe lines for water supply systems). Teknisk Tidskrift, Heft 9, 1913.

The following translation has been made at the National Bureau of Standards (National Hydraulic Laboratory):-

Dillman, O. - Untersuchungen an Ueberfällen (Investigations of the flow over weirs). Mitteilungen des Hydraulischen Instituts der Technischen Hochschule München, Heft 7, 1933. Translation by H. N. Eaton. Available for loan after February 1, 1936.

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Hungary.

Hydraulic Proceedings of the Royal Hungarian Ministry of Agriculture, Volume XV, No. 1, January-March, 1933. (Only the English abstracts are on file, and only the articles of greatest interest and within the scope of this Bulletin are listed here).

Contents:

3. J. Janicsek. Fundamental concepts of soil mechanics and their application in hydraulic engineering. Part I.
4. H. Lampl. Classification and practical determination of sedimentary subsoils from the engineer's point of view.

Hydraulic Proceedings of the Royal Hungarian Ministry of Agriculture, Volume XV, No. 2, January-March, 1933. (Only the English abstracts are on file, and only the articles of the greatest interest and within the scope of this Bulletin are listed here).

4. J. Janicsek. Fundamental concepts of soil mechanics and their application in hydraulic engineering. Part II.
6. R. Ballenegger. The physics of soil.
13. B. de Kenessey. Profiles of watercourses (canals).

Hydraulic Proceedings of the Royal Hungarian Ministry of Agriculture, Volume XVI, No. 1, January-March, 1934. (In Hungarian with English summaries).

Contents:

1. J. Cholnoky. Relation of the regional character of rivers to their improvement and to irrigation.
2. W . Laszloffy. Water conditions of the Hungarian Danube.
3. L. Avjesky. The regime of the Danube: its meteorological relations.
4. A. Rethly. Rainfall conditions of the Hungarian Great Plains and Meteorological reasons for their afforestation.
5. E. Nemeth. Methods used in Italy for determining water volumes to be carried down in drainage canals.
6. E. Korpas. The island of Csepel.
7. W. Laszloffy. Protection of the rear apron of overflow dams.
8. D. Ihrig. Repair of the pumping plant at Karapancsa.
9. J. Kerekes. Rainfall in May.
10. B. Taxner. The filling up of gullies.

Hydraulic Proceedings of the Royal Hungarian Ministry of Agriculture, Volume XVI, No. 2, April-June, 1934. (In Hungarian with English summaries.)

Contents.

1. L. Kun. The waterways of France.
2. F. Hajosy. Values of the mean monthly and annual rainfall in Hungary,
3. B. de Kenessy. Water management in the Hungarian Great Plains.
4. G. Lapray. Irrigation and utilization of water power along the lower Piave on the territory of the Brentella di Pederobba Company,
5. Elwood Mead. Modern methods used in reclamation projects.
6. Gy. Pogonyi. Snow and ice conditions in the watershed area of the Danube, the Tiza and their tributaries in the winter of 1933-34.

Hydraulic Proceedings of the Royal Hungarian Ministry of Agriculture, Vol. XVI, No. 3, July-September, 1934. (In Hungarian with English summary.)

Contents:

1. W. Laszloffy. Ice conditions of rivers, with special consideration of the Hungarian Danube.
2. I. Tinko. Agrogeologic conditions of the flood area in Borsod County. Not summarized.
3. J. Szilagyi. Sewage treatment adjacent to a watercourse.
4. A. Trummer. Fascine works for stabilizing gullies.
5. A. Trummer. Regional character of river sections and irrigation in lowlands.
6. A. Siko. Determination of the water volume flowing through orifices of different form, with special regard to dams built for stabilizing gullies.
7. Gy. Pogonyi. A study trip on the upper Danube.

Hydraulic Proceedings of the Royal Hungarian Ministry of Agriculture, Vol. XVI, No. 4, October-December, 1934.

Contents:

2. B. Kenessey. Spray irrigation.
3. E. Nemeth. Association for hydraulic affairs and hydraulic congresses in Italy.
4. R. Papp. Organization of the construction of large hydraulic structures.
5. E. Nemeth. Drops and chutes (description and further development of the method of M. A. Mantilla, engineer in Mexico.
6. J. Dieter. The earth dam at Recsk.
7. B. Zoltan. Production of concrete artificial stone; the use of puzzolana for bank protection works on the Mura river.
8. A. Siko. Investigation of the subsoil, Burkhardt's auger.
9. K. Szabo. The catchment area of Lake Velence.

Hydraulic Proceedings of the Royal Hungarian Ministry of Agriculture, Volume XVII, No. 1, January-March, 1935 (In Hungarian with English summary.)

Contents:

1. J. Dieter. The quay walls of the Budapest duty-free harbor and the Budapest-Ferencvaros local harbor.
2. R. Paunz. Foundations of the smaller buildings on the lower reach of the Soroksar Danube branch.
3. K. Szechy. Foundations laid by the well-point method in Hungary.
4. U. Kiewitz. Pumps on a new system in the service of surface drainage.
5. G. Posewitz. Geology of the Rokus mountain, with special regard to landslips.
6. D. Molnar. Removal of iron and manganese at the waterworks plant of Budapest.
7. H. H. Bennett and W. Q. Chapine. Soil erosion a national menace. Translated by K. Gubanyi.
8. L. Aujeszky. Influence of the force and velocity of the wind and the different sorts of air on evaporation.

Hydraulic Proceedings of the Royal Hungarian Ministry of Agriculture, Volume XVII, No. 2, April-July, 1935. (In Hungarian with English summary).

Contents:

1. J. Cholnoky. The significance of rice production in the history of civilization.
2. K. Gubanyi. Rice.
3. E. Zboray. Rice production in Java.
4. F. Fodor. Former hydrographic conditions of the lowland basin of the Zagyva River.
5. H. Lampl. The risk to sluices and pumping plants built on bad subsoil and under trying conditions, and their examination as to flood protection.
6. S. Molnar. Restoring works on the pumping plant at Decs.
7. B. Resli. Restoring works on the pumping plant at Ersekcsanad.
8. J. Zeitvogel. Restoring works on the pumping plant at Kölked.
9. L. Vojcsik. Maintenance of water supply systems.
10. D. Molnar. Supply with surface water and purification arrangements.
11. Arthur Powell Davis. Irrigation in Turkestan.
13. W. Laszloffy. Testing current meters in the Hydrotechnical Institute of the University of Toulouse.
14. Gy. Berzsenyi. A new hydrographic survey of the Tisza River,

INDIA.

Irrigation Canal Falls. Central Board of Irrigation, Publication No. 10, Simla, February, 1935.

ITALY.

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G. B. Ugolini. Il Gabinetto di Idraulica Agraria presso l'Istituto Superiore di Ingegneria di Padova (The Laboratory of Agricultural Hydraulics at the Royal School of Engineering at Padua. Third National Congress of Italian Engineers, Trieste, May 30 - June 2, 1935.

Igidio Indri. Sulla forza di trascinamento delle corrente liquide (On the tractive force of liquid currents.) Reprint from L'Energia Elettrica, Fascicolo XII, Vol. XI, December, 1934.

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Ettore Scimemi. Sui getti liquidi (On liquid jets).

Ettore Scimemi. Il laboratorio di Idraulica nel R. Istituto Superiore di Ingegneria di Padova e le sui ricerche. (The Hydraulic Laboratory of the Royal School of Engineering at Padua and its investigations). Reprint from L'Energia Elettrica, Fascicolo IX, Vol. XII, September, 1935.

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Contents:

1. B. F. Reltov. Percolation of ground water investigated as a three-dimensional problem by means of the electro-hydrodynamical analogy proposed by Professor N.N.Pavlovsky.
2. L. A. Velikanof. Hydromechanical analysis of runoff.
3. M. A. Dementiev. Interference of two solid bodies in a stream of fluid.
4. V. I. Aravin. Determination of length of hydraulic jump.
5. A. N. Patrashev. Pressure flow of ground water carrying fine sandy and clayey particles.
6. I. I. Levy. Hydraulic design of sluice openings.
7. A. A. Korolev. Hydraulic design of canal transitions.
8. B. V. Archangelsky. Experimental investigation of the accuracy of elutriation scales used in grain-size distribution analyses.
9. F. I. Bydin. Investigations relating to methods of forecasting ice conditions.
10. Short notes: (no English summaries).
    (a) D. N. Bibikov. Use of electrical thermometers for investigation of hydrotechnical structures.
    (b) N. L. Ioungkind. Use of compressed air for combatting ice troubles at Magnitostroy Dam.

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Contents:

1. N. N. Pavlovsky. Principles to be followed in working movable dams in order to reduce undermining to a minimum.
2. V. E. Timonoff. On the theoretical basis for the establishment of a working hypothesis for explanation of ice phenomena in lakes and rivers.

3. M. V. Malyshev. Determination of power necessary for warming trash racks of intake structures.
4. B. V. Proskuriakov and D. N. Bibikov. Forecast of temperatures in natural bodies of water.
5. A. N. Patrashev. Pressure flow of ground water carrying fine sandy and clayey particles. Part I. Silting of soil skeletons.
6. V. I. Aravin. Percolation from reservoirs.
7. B. V. Proskuriakov. Theory of thermal regime of trickling cooling plants.
8. A. I. Schwarz. Flow of water in channels curved in vertical plane to an arc of a circle.
9. V. V. Kind. Methods for rapid determination of resistivity of cements against mineralized waters.
10. N. N. Jagodin. Investigation of silt movement at the Kadyria Hydroelectric Plant.
11. G. I. Shamov. Investigation of morphological types of formation of cross bars and of flood-plain deposits of the Volga River.
12. Short notes: (No English summaries).
    (a) A. F. Burkov. Design of hydraulic regime below overflow dams with long spillways.
    (b) G. I. Shamov. Brief information regarding the results of laboratory tests of silt samplers.

U. S. S. R. Commission for the Exchange of Hydraulic Research Results, Bulletin No. 4, Leningrad, 1935. (In Russian). This bulletin is a translation of Bulletins I-1, 2 and 3, "Current Hydraulic Laboratory Research in the United States".

U. S. S. R. Commission for the Exchange of Hydraulic Research Results, Bulletin No. 5, Leningrad, 1935. (In English). This bulletin contains a list of hydraulic research projects in progress in the U.S.S.R. in 1935 arranged in the same form as in the bulletins, "Current Hydraulic Laboratory Research in the United States".

HYDRAULIC RESEARCH IN INDIA.

by the Irrigation Research Division, Bombay, Deccan.

(From the Minutes of the Fourth Meeting of the Research Committee of the Central Board of Irrigation, held in Simla on July 19 and 20, 1934).

"The following is a list of the principal tests and investigations:

(i) Experiments with the Barrage model at Khadakvasla to determine the effect of large radius vanes on excluding bed silt from the Barrage Canals.
(ii) Silt control at off-takes from alluvial rivers.
(iii) Experiments for finding the co-efficient of discharge of the Barrage gates.
(iv) Experiments to determine co-efficient of discharge of the Tando Mastikhan flumed fall (Rohri Canal, Sind).
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The Scientific Research Institute for Hydrotechnics at Leningrad.

(The following information is taken from Bulletin No. 5 of the U.S.S.R. Commission for Exchange of Hydraulic Laboratory Research Results.)

There are now more than thirty hydraulic, hydroelectric and hydrotechnical laboratories in the U.S.S.R., located in Kharkov, Odessa, Baku, Novocherkassk, Tiflis, Tashkent, Moscow and Leningrad.

The largest group of laboratories is located in Leningrad, where the Scientific Research Institute of Hydrotechnics, including nineteen laboratories, has been created, with P. N. Provorov as director. The individual laboratories belonging to this group are listed below:

1. Division of engineering hydraulics. Director: Prof. N.N. Pavlovsky.
2. Hydroelectric laboratory. Director: Prof. J. B. Egiazaroff.
3. Hydrotechnical laboratory. (No. 1). Director: S.V.Isbash.
4. Small hydrotechnical laboratory (No. 2). Director: L.A.Narkevich.
5. Large hydrotechnical laboratory (No. 3). Director: P.A.Voinovich.
6. Hydrotechnical laboratory for silt studies and head works investigations. Director: Prof. I.I.Levy.
7. River hydraulics laboratory. Director: Prof. N.M.Bernadsky.
8. Soils and hydrotechnical structures laboratory. Director: Prof. N.P.Pouzirevsky.
9. Soil mechanics laboratory. Director: R.N.Davidenkov.
10. Laboratory for physical and mechanical analyses of soils. Director: B.V.Archanguelsky.
11. Electro-hydrodynamical analogy laboratory. Director: B. F. Reltov.
12. Hydro-physical laboratory. Director: B.F.Reltov.
13. Hydromechanical laboratory. Director: M.A.Dementriev.
14. Hydrothermic laboratory. Director: B. V. Proskuriakov.

15. Division of ice engineering. Director: Prof. V. E. Timonov.
16. Division of statical methods of structural analysis. Director: Prof. B. G. Galerkin.
17. Division of special field investigations. Director: A. T. Potapov.
18. Division of organization and mechanization of construction operation. Director: Prof. V. K. Bèklovsky.
19. Division of structural materials used in hydrotechnical construction. Director: Prof. V. V. Kind.

The reports on the investigations conducted by the Institute are published in the Transactions of the Scientific Research Institute for Hydrotechnics in Russian, usually with summaries in English.

See article by I. Gutmann, "Russia creates a great laboratory for hydraulic research", Eng. News-Record, Vol. 112, No. 24, June 14, 1934, pp 761-766.

U.S.S.R. COMMISSION FOR EXCHANGE OF HYDRAULIC LABORATORY RESEARCH RESULTS.

(The following information is taken from Bulletin No. 5, 1935, of the above-named Commission.)

The U.S.S.R. Commission for Exchange of Hydraulic Laboratory Research Results was formed early in 1933 and immediately commenced corresponding with foreign laboratories and those in the U.S.S.R. At the present it is corresponding with 75 foreign laboratories distributed as follows: 30 in the United States, 19 in Germany, 5 in France, 4 in Italy, 4 in Sweden, 3 in Austria, 3 in Czechoslovakia, 2 in Holland, and one each in England, Switzerland, Belgium, Hungary and Latvia.

The Commission is attached to the U.S.S.R. Committee for Participation in World Power Conferences. It is headed by the following:

Professor J. B. Egiazaroff, President, Director of the Hydroelectric Laboratory, Scientific Research Institute for Hydrotechnics,

G. K. Parsian, Vice-President, Head of the Water Resources Department of the State Planning Commission, and

P. N. Provorov, Member, Director of the Scientific Research Institute of Hydrotechnics.

The Commission publishes a bulletin for the purpose of keeping the Soviet laboratories informed as to the work that it is doing and also for disseminating the information and data that it receives from abroad. Five issues of this bulletin have appeared up to the present time. The first three, in Russian, contain information regarding the activities of the

Commission; the fourth, also in Russian, is a translation of Bulletins I-1, 2 and 3, "Current Hydraulic Laboratory Research in the United States", issued by the National Bureau of Standards. The fifth, published both in Russian and in English, describes current hydraulic research in the U. S. S. R. during 1935.

Bulletin No. 5 lists 141 projects under way in the Scientific Research Institute of Hydrotechnics at Leningrad during 1935. The space required to list the titles of these projects would be too great for the purposes of this bulletin; however, the general subjects under investigation are as follows: Groundwater studies, percolation, silting of reservoirs and canals, use of rotating screens for removing sediment, ejectors for flushing out bed load, study of bed load samplers, movement of bed load, properties of soils, stresses in soils, methods of mechanical analysis of sediment, stability of dams, study of coffer dams, water cushions, energy dissipators, studies of hydr-electric structures, tunnel entrances, spillways for regulating dams, fish ladders, intake structures, field tests of hydro-electric structures, study of wood-stave penstocks, movement of waves, wave impact, model scales, design of fixed-bed models, measurement of water levels, water-level fluctuations during lockage, vertical velocity distribution in open channels, surge tanks, water hammer, rate of fall of particles in still water, boundary layer, molecular structure of filaments of flowing liquids, river morphology, solution of problems by the electrical analogy method, solution of harmonic functions by the electrical analogy, evaporation, vertical temperature gradients, temperatures in a stream of water, processes occurring in water as it freezes, ice formation in open channels, ice thrust on structures, design of canals to meet winter conditions, formation of ice on trash racks, classification of and terms for the principal types of ice formation, development of special testing equipment, studies of stresses in hollow, thin-walled cylinders, use of the optical method for the analysis of dams, preparation of handbooks and information on construction problems, studies of cements, mortars and concrete.

INTERNATIONAL ASSOCIATION FOR RESEARCH ON HYDRAULIC STRUCTURES.

The movement that was then under way to establish this organization was described briefly in Bulletin I-3, "Current Hydraulic Laboratory Research in the United States," October, 1933. The Association was finally founded in September, 1935, at Brussels by a group of prominent hydraulic engineers from Austria, Belgium, Czechoslovakia, Denmark, France, Germany, Holland, Hungary, Italy, Sweden, Switzerland and the U.S.S.R. Tentative articles of association were drawn up and accepted, to be in force until the first regular meeting of the Association can be held, presumably in 1936, at which time permanent articles will be adopted.

The meeting at Brussels elected Professor Wolmar Fellenius of Stockholm President of the Association and chose a provisional committee consisting of J. Blockmans (Antwerp), C. Camichel (Toulouse), H. N. Eaton (Washington), J. B. Egiazaroff (Leningrad), W. Fellenius (Stockholm), A. H. Gibson (Manchester), E. Meyer-Peter (Zurich), Th. Rehbock (Karlsruhe), A. Rohringer (Budapest), F. Schaffernak (Vienna), E. Scimemi (Padua), R. Seifert (Berlin), J. Smetana (Prague) and H. Th. Thijsse (Delft). A provisional executive committee, consisting of Messrs. Fellenius, Seifert and Thijsse, was elected.

It is hoped that eligible engineers, scientists and organizations in the United States will join the Association promptly in order that the Association may be able to start effective work at once. The Association will have to depend entirely upon membership dues at first to finance its activities. Dues (10 reichsmarks for individual members) for the calendar year 1936 should be sent to the President, Professor Wolmar Fellenius, Kungl. Tekniska Högskolan, Stockholm, Sweden, together with the application for membership. No special application form is required for this purpose. Further information can be obtained from Herbert N. Eaton, National Hydraulic Laboratory, National Bureau of Standards, Washington, D. C.

Proposed Articles of Association for an International Association for Research on Hydraulic Structures.

1. Name of the Association.

The name of the association shall be: The International Association for Research on Hydraulic Structures.

2. Object of the Association.

The object of the Association shall be to promote the international cooperation of those persons who are interested in research relating to hydraulic structures and to enable such persons to exchange their views, experience and knowledge.

The best way of attaining this objective is to hold periodic international meetings at intervals of not less than two and not more than four years. These meetings should be held preferably in connection with meetings of the World Power Conference, meetings of the Congress on Large Dams or meetings of the Permanent International Association of Navigation Congresses.

However, the Association shall be free to use other means in order to promote international collaboration in connection with research on hydraulic structures.

3. Membership.

The Association shall consist of:

I. Individual members.
II. Corporate members.

Any one who is interested in hydraulic research can become an individual member if he is: (a) Professor of hydraulics or of any related subject at an engineering college, at a university or at any other equivalent educational institution, (b) Director of a hydraulic laboratory or an employee holding an administrative position at such a laboratory, (c) Member of a prominent scientific or engineering society.

The corporate membership is open for: (a) Departments of hydraulics or of related subjects at an engineering college, at a university or at an equivalent educational institution, (b) Hydraulic laboratories, (c) National

or other committees of the World Power Conference, of the International Congress on Large Dams and of the Permanent International Association of Navigation Congresses, (d) Public organizations which project, execute and supervise hydraulic works.

4. Contributions.

The annual contribution for an individual member shall be 10 reichsmarks and for a corporate member a minimum of 50 reichsmarks.

Individual members can secure life membership upon payment of 100 reichsmarks.

5. Voting power.

At the meetings each individual member present and each corporate member represented shall have one vote.

The right of a corporate member to vote shall be exercised by a representative designated by the corporation and present at the meeting. Such a representative, if an individual member, may also vote as such. However, no individual shall be entitled to more than two votes.

6. Administration of the Association.

The Association shall be directed and represented by a Permanent Committee, which shall be composed of seven members, the President of the Association, two Vice-presidents of the Association, the Secretary of the Association and three other members.

The members of the Permanent Committee shall be elected at the meetings of the members of the Association and shall hold office until the end of the calendar-year in which the next meeting is held.

The President and the two Vice-presidents shall not be from the same country, and not more than three of the members shall be from the same country. The members of the Permanent Committee shall be eligible for re-election, subject to the restriction that at each election at least two new members shall be elected.

7. The Permanent Committee.

The Permanent Committee shall meet at least once in every calendar-year. It shall be the duty of this committee to make the necessary preparations for the meetings of the Association and to appoint the committee that is to be in charge of the meetings, as well as the officials thereof.

The Permanent Committee shall have the power to elect from its own membership an Executive Committee and to appoint subcommittees for special purposes. It shall have a right to invite governments and officials to participate in the meetings of the Association. It shall be the duty of the Permanent Committee to present at each meeting of the Association a report on the administration and the financial condition of the Association up to the end of the preceding calendar year.

8. Duties of the President.

The President of the Permanent Committee, or one of the Vice-presidents as his substitute, shall preside over the assemblies of the Permanent Committee, as well as over the meetings of the Association. He shall represent the Association in all matters of importance.

9. Duties of the Secretary.

It shall be the duty of the Secretary to handle the correspondence, to collect the annual contributions and to fulfill the duties of treasurer of the Association. All expenses shall be defrayed from the financial resources of the Association, with the approval of the Permanent Committee.

The Secretary shall transmit the administrative and financial report of the Permanent Committee to the controllers at least two months prior to the next meeting.

10. The Controllers and the discharge of the Permanent Committee.

The meetings of the Association shall choose two Controllers when the vote for the Permanent Committee is taken. It shall be the duty of the Controllers to submit at the next meeting a review of the administration of the Permanent Committee and an auditor's report on the financial report of the Secretary.

On the strength of the Controller's report, the meeting shall discharge the Permanent Committee.

Temporary provisions.

If, at the meeting of those interested in research on hydraulic structures to be held in Brussels in September, 1935, the decision is made to found the Association and if these Articles of Association - with modifications, if any - are accepted provisionally, a Provisional Committee shall be elected at this meeting and shall act as a Permanent Committee until the first meeting of the Association, essentially in accordance with these articles. This committee is instructed particularly to organize the Association and to obtain members. It shall make preparations for the first meeting and shall submit the revised articles for approval at this meeting.

Copy of the letter of foundation.

The undersigned herewith found the International Association for Hydraulic Structures Research with provisional articles of association as per the project enclosed.

Brussels, September 3rd, 1935.

Th. Rehbock	Karlsruhe.	J. Th. Thijsee	Delft.
Wolmar Fellenius	Stockholm.	Wittman	Karlsruhe.
Egiazaroff	Leningrad.	Seifert	Berlin.
G. Schinweller	Copenhagen.	Schaffernak	Vienna.
Alexander Rohringer	Budapest.	J. Smetana	Prague.

H. Favre	Zurich.	Scimemi	Padua.
Leon Tison	Ghent.	K. Dantscher	Munich.
A. Strucky	Lausanne.	J. Bazant	Brünn.
F. Campus	Liege.	K. Kotska	Brünn.
J. Blockmans	Antwerp.	Agatz	Berlin.
Jean Laurent	Paris.	Smrcek	Brünn.

HYDRAULIC RESEARCH COMMITTEES.

Committee on Dynamics of Streams, Section of Hydrology, American Geophysical Union.

Chairman: Professor Lorenz G. Straub,
University of Minnesota,
Minneapolis, Minnesota.

No report. See Bulletin III-2, p. 79.

Transportation Sub-Committee of the Petroleum Division of the American Society of Mechanical Engineers.

Chairman: W. G. Heltzel.
Stanolind Pipe Line Company,
Philcade Building,
Tulsa, Oklahoma.

No report. See Bulletin III-2, p. 79.

Special Committee on Hydraulic Research, American Society of Civil Engineers.

This committee was appointed in April, 1934. At present it is undertaking:

To encourage hydraulic research by those agencies having facilities and personnel to undertake it.

To prepare a standard set of symbols and glossary for model investigation.

To supply worthy problems for those desiring to undertake research and to act in an advisory capacity regarding them.

In order to carry out this program we are assigning a number of primary fundamental problems to certain individuals having the facilities and willingness for research. A committee is at work on the preparation of a set of standard symbols. Another committee is securing data on the conformity of model to prototype. A third committee has a list of what might be called secondary or practical research problems that can be given to students and others desiring to undertake them.

In addition to the above the committee has in preparation a manual on hydraulic laboratory practice.

The committee will devote its major activities to open channel flow, and flow in closed channels will only be included as a necessary adjunct to open channel phenomena.

The personnel of the committee follows:

J. C. Stevens, Chairman
Herbert D. Vogel, Secretary
Clarence E. Bardsley
E. W. Lane
L. G. Straub
Chilton A. Wright.

Committee on Absorption and Transpiration, Section of Hydrology, American Geophysical Union.

Functions of Committee.

The work of this committee relates to the absorption of rain, snow, and stream water into the earth and its penetration to the water table; the discharge of water by evaporation from the soil and by the transpiration of plants; and the effects of intake and discharge on the ground-water levels. The work of this committee touches also the fields of soil physics, runoff and underground water.

The Committee on Absorption and Transpiration was organized as one of the permanent research committees of the Section of Hydrology, American Geophysical Union, in the spring of 1932. It endeavors to undertake (a) to stimulate research work within its field, (b) to obtain the preparation of papers pertinent to its field of activity, (c) to secure coordination of workers and correlation of the results of research within the different branches of its field, (d) to facilitate dissemination of literature in its field, and (e) to standardize and define terminology within its field.

A report is prepared annually by the committee and presented at the annual spring meeting of the American Geophysical Union. These reports have been published in the past in the Transactions of the American Geophysical Union, National Research Council.

Members of Committee.

Charles H. Lee, Chairman

Harry F. Blaney
Lynn Crandall
S. T. Harding
Charles R. Hursh
B. E. Livingston
W. C. Lowdermilk
G. E. P. Smith
W. N. White.

John E. Weaver (resigned June 25, 1935).

COMMITTEE FOR RESEARCH ON HYDRAULIC FRICTION

This committee has been appointed by the Division of Engineering and Industrial Research of the National Research Council. Membership on the committee is as follows:

Theodor von Karman, Chairman; Professor of Aeronautics and Director; Daniel Guggenheim Laboratory, California Institute of Technology, Pasadena, California.

B. A. Bakhmeteff, Vice-chairman; Professor of Civil Engineering, Columbia University, New York, N. Y.

Morrough P. O'Brien, Secretary; Associate Professor of Mechanical Engineering, University of California, Berkeley.

Lyman J. Briggs, Director, National Bureau of Standards, Washington, D. C.

E. W . Lane, Professor of Hydraulics, State University of Iowa, Iowa City, Iowa.

Lewis F. Moody, Professor of Hydraulic Engineering, Princeton University, Princeton, N. J.

Fred C. Scobey, Bureau of Agricultural Engineering, U. S. Department of Agriculture, Berkeley, California.

The immediate purpose of the committee is to review theoretical and experimental studies of hydraulic friction for the flow of homogeneous fluids in straight pipes without joints and in straight open channels of simple geometrical and constant cross-section for conditions showing negligible effect of compressibility. Later work of the committee may cover other aspects of fluid friction.

The committee proposes to prepare a report in the near future and will also prepare a list of experiments which will be recommended to the laboratories interested in this problem. The first report of the committee will cover the following items:

Statement of aims of committee
Glossary of terms
Theoretical treatment of problem of hydraulic friction
Laboratory experiments on friction losses and velocity distribution in small closed conduits.
Laboratory experiments on friction losses in small open channels
Field measurements of friction losses in open and closed conduits
Field measurements of velocity distribution in open and closed conduits.

Morrough P. O'Brien,
Secretary.

GLOSSARIES AND STANDARD SYMBOLS FOR USE IN HYDRAULICS.

The American Society of Civil Engineers has issued a Manual of Engineering Practice, No. 11, "Letter Symbols and Glossary for Hydraulics, with Special Reference to Irrigation", under date of October 13, 1935. This manual was prepared by the Special Committee on Irrigation Hydraulics.

The Special Committee on Hydraulic Research of the American Society of Civil Engineers is planning to prepare a set of standard symbols and a glossary in connection with model studies in hydraulics. See page 96 of this bulletin.

The Committee for Research on Hydraulic Friction is preparing a glossary of terms relating to fluid flow in straight pipes and open channels. The first draft has been prepared and is in the hands of the various members of the committee for consideration. See page 98 of this bulletin.

The Committee on Symbols and Abbreviations of the American Standards Association is about to rewrite its present standards of symbols, including those used in hydraulics, according to a note in Civil Engineering, Vol. 6, No. 1, January, 1936, page 74.

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